IN THE UNITED STATES DISTRICT COURT FOR THE
NORTHERN DISTRICT OF OKLAHOMA

W. A. DREW EDMONDSON, in his capacity as ATTORNEY GENERAL OF THE STATE OF OKLAHOMA and OKLAHOMA SECRETARY OF THE ENVIRONMENT C. MILES TOLBERT, in his capacity as the TRUSTEE FOR NATURAL RESOURCES FOR THE STATE OF OKLAHOMA, Plaintiff,	
vs.	4:05-CV-00329-TCK-SAJ
TYSON FOODS, INC., et al, Defendants.	

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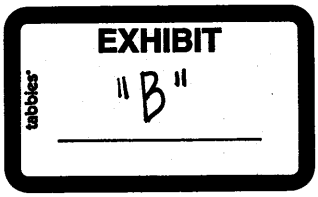
VOLUME I OF THE VIDEOTAPED

DEPOSITION OF VICTOR BIERMAN, PhD, produced as a witness on behalf of the Plaintiff in the above styled and numbered cause, taken on the 14th day of April, 2009, in the City of Tulsa, County of Tulsa, State of Oklahoma, before me, Lisa A. Steinmeyer, a Certified Shorthand Reporter, duly certified under and by virtue of the laws of the State of Oklahoma.



APPEARANCES

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ALSO PRESENT: Dr. Bernard Engel

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(Whereupon, the deposition began at 9:00 a.m.)

VIDEOGRAPHER: We are now on the Record for the deposition of Dr. Victor Bierman. Today is April 14th, 2009. The time is 9:00 a.m. Counsel, please identify yourselves for the Record? 09:00AM

MR. PAGE: David Page representing the State of Oklahoma, and with me is Dr. Engel.

MR. BOND: Michael Bond representing Tyson Foods, Tyson Poultry, Tyson Chicken and Cobb-Vantress. 09:00AM

MR. FREEMAN: Bruce Freeman from Conner & Winters here for Simmons.

MR. LEWIS: Kerry Lewis here on behalf of the Cargill defendants. 09:00AM

VIDEOGRAPHER: Thank you. You may swear in the witness.

VICTOR BIERMAN, PhD

having first been duly sworn to testify the truth, the whole truth and nothing but the truth, testified as follows:

DIRECT EXAMINATION

BY MR. PAGE:

Q Good morning, Dr. Bierman.

A Good morning. 09:00AM

Q Would you please give us your full name and address for the Record?

A My name is Victor J. Bierman, Junior. My address is 8320 West Harrell Road, Oak Ridge, North Carolina 27310. 09:01AM

Q Dr. Bierman, have you ever given sworn testimony in the past, any kind of deposition or trial testimony?

A Yes.

Q Okay. What I'd like to do is have you go back in time with me and identify for me the times in which you have given testimony under oath like we are today, either deposition or at trial. Again, I'm only interested in times when you've been called upon to provide expert testimony any kind of civil dispute. For example, like a traffic accident, you might have been a witness to I'm not interested in that, and as you go through, if you could just identify approximately when you gave the testimony, the court and then the subject matters you provided testimony on. Okay? 09:01AM 09:01AM

A Sure.

Q So maybe whichever is most easiest, but maybe you can go in reverse chronological order the best you recall, and if by chance it would help to have 09:02AM

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Q Sure.
A -- with that label.
Q You mentioned that you evaluated overland transport. I assume that was from the plant site to the streams that were at issue; correct? 09:15AM
A Yes, that's correct.
Q How did you evaluate overland transport in the Ohio litigation?
A As I recall, we had information on -- some of it was anecdotal information and some of it was 09:15AM taken from the company records and some of it was taken from depositions of workers at the plant. For example, it was established that highly contaminated Mirex waste from the manufacturing process was simply disposed of in open lagoons, and when it 09:16AM rained, these lagoons were -- simply overflowed, and the overflow was observed visually and described visually as flowing down the hill to the stream. There were other descriptions of when these lagoons got full. Sometimes they would be bulldozed, and 09:16AM the contents would simply be bulldozed down the hill.
So it was established that -- and then to support that, there was also a groundwater plume. We had groundwater measurements at various points in 09:16AM

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space, and these indicated that there had been off-site migration of Mirex from the plant site.
Q These deposition and other witness observations, did you consider them relevant in your investigation as to whether or not Mirex had 09:17AM migrated off the site into the streams?
A I didn't need information from those depositions to determine Mirex had migrated off the site because there was only one source of Mirex in the vicinity, and Mirex was measured in soil, in 09:17AM groundwater and in the stream and at locations off the site. So I know it got there.
Q Doctor, I'm sorry, I'm going to interrupt. I don't think you answered my question. My question was whether you used this evidence, not whether or 09:17AM not you needed to use it. I think you're answering the second question.
I was asking whether or not you used this information, these observations of the overflow and the bulldozing, as part of your determination that 09:18AM there had been overland transport. Did you use them or not?
MR. BOND: I think that's a different question. I think you asked him whether or not he considered them to be relevant, and I think he 09:18AM

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answered that.
Q Did you use the information, sir?
A For what purpose?
Q To determine whether or not there was overland transport. 09:18AM
A In the sense that that information confirmed what I had already determined independently from looking at the data and from knowing that there was only one Mirex source there.
Q Okay. Did you do any runoff modeling in the 09:18AM Ohio litigation?
A No, I didn't do any modeling as part of that investigation.
Q Did you prepare a report?
A I prepared several declar -- excuse me. I 09:18AM prepared several declarations, but I did not prepare an expert report.
Q Do you still have those declarations?
A I don't have them with me here today, but I probably do have them in my files. 09:19AM
Q Okay. Let's go to the next time you testified, sir.
A Uh-huh.
Q Would you identify that for us, please?
A Sure. It's the next to the last item on Page 09:19AM

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A-2 in my -- in Appendix A-2 in my expert report. Litigation support for U. S. Department of Justice in case involving municipal discharger. There were two phases to that case, 1994 and 1995, and then 1998 through 1999. 09:19AM
Q Okay, and did you give deposition testimony in that case?
A Yes, I did.
Q And did you give trial testimony?
A No, I did not. The case settled before it 09:20AM went to trial.
Q Okay, and where was that case venued?
A I believe that was a federal district court. It was either in Chicago or in the Chicago vicinity. It might have been Indiana. The question was the 09:20AM Hammond sanitary district plant which is in Hammond, Indiana.
Q How do you spell Hammond?
A Hammond is H-A-M-M-O-N-D.
Q So that particular facility was at issue in 09:20AM the case?
A Yes, that's correct.
Q Okay, and what were the areas of your expert evaluation for that case?
A I was an expert witness for the plaintiffs, 09:20AM

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the Justice Department and the U. S. Environmental Protection Agency. I believe it was an EPA suit joined by the Justice Department or vice versa.

The issue was that the Hammond sanitary district plant was in violation of its permit and it was discharging excessive amounts of various pollutants from the wastewater treatment plant, as well as I recall from combined sewer overflows, or were they storm sewers, I can't remember, and these discharges had negative impacts on the east and west branch of the Calumet River. 09:21AM

Q And what opinions did you provide in that case for the government?

A Well, I prepared a written expert report, and my opinions pertained to the -- back up. Another expert in the case conducted an investigation in the watershed and provided me with the non-point source loadings. Either he or still a third expert in the case provided me with the wastewater treatment plant loadings. My work on that case involved the receiving water, the impact of those loadings on the east and west branches of the Calumet River. 09:22AM

Q So you took the information from the expert that provided the non-point source loading and combined that with the expert information from 09:22AM

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wastewater treatment plant loading and then from that information determined effects of those loadings on downstream locations; is that correct?

A Not the effects. It was transport and fate.

Q Okay. So you did kind of the in-stream analysis of those pollutants? 09:23AM

A I did the in-stream analysis of the pollutants, and I computed the impact of those pollutants on the exposure levels, concentration levels in the stream, and I believe I also computed the delivery, the mass delivery of those pollutants to -- out the system. I forget -- I forget what the eastern boundary of the system is and I forget right now what the western boundary of the system was, but we looked at the loadings of the constituents outside the boundaries. 09:23AM

Q What were the chemicals or pollutants of concern in that case?

A Solids was one of them.

Q Total organic carbon, or what do you mean by solids? 09:24AM

A Solids expressed as total suspended solids.

Q Total suspended solids?

A Yes.

Q Okay.

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A There were several toxic chemicals. I can't recall what they are at the moment. I think there was some metals. I know there were some metals, and I think there was one organic.

Q Organic chemical? 09:24AM

A Organic chemical.

Q Were there any nutrients at issue in that case?

A I don't recall that nutrients were an issue in that case. 09:24AM

Q What in-stream modeling -- did you use an in-stream model in that case?

A Yes.

Q What model did you employ?

A We used a version of WASP, the Water Analysis Simulation Program. I say a version of it because I believe we took the working equations and wrote our own model, but it was a WASP model. 09:24AM

Q How did the other expert determine the wastewater treatment plant loadings? 09:25AM

A I can't recall the details at this moment, but the permit did require monitoring. There are discharge monitoring records, I believe they were used, but I can't recall for sure.

Q How did you employ the data from the 09:25AM

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wastewater treatment plant loadings in your analysis?

A We conducted simulations for a period of time. I can't remember what the period was. It might have been some months or a year perhaps, two years. I can't remember. We used the loadings of flow and chemical constituents as inputs to our mass balance model. 09:25AM

Q So you took the -- is it your recall that you got information concerning flows from the different wastewater treatment plants in the concentrations, then determined loadings from that? 09:26AM

A I recollect there was only one plant, but there were several different discharge locations for the CSOs. We were given -- I know we were given flows. I think we were given mass loads, but it was a long time ago. We may have been given concentrations. I don't recall that we did any mass load calculations. My recollection is that we were given flows and that we were given loads. 09:26AM

Q What did you mean by CSOs?

A Combined sewer overflows.

Q Okay, and those overflows were also calculated by another expert in the contribution?

A Yes, that's correct. 09:27AM

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Q And you mentioned a watershed non-point source contribution also that was evaluated?
A I can't recall at the moment whether the loads I was provided were only the CSO loads or they included loads from other portions of the watershed. 09:27AM I believe they include -- I believe they did.
Q Okay, and do you know how those non-point source loadings were determined?
A I don't recall, but I think it was a simple spreadsheet calculation. 09:27AM
Q What do you mean by that?
A My recollection is that the expert accounted for the area of the watershed and perhaps accounted for different land uses, although I can't recollect that, and assigned unit area loads to the areas and 09:28AM then considered precipitation and estimated runoff. That's my best recollection.
Q Do you recall whether the expert used coefficients for the different potential runoffs to determine the concentrations in loads? 09:28AM
A I can't recall that level of detail.
Q Okay. Let's -- what was the next litigation that you were involved with, sir?
A The next item is litigation support for Hudson River and natural resource damage assessment. This 09:28AM

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would be during 2003 through 2005.
Q Did you give any testimony in that case?
A No, I actually did not give testimony in that case. That case -- I was only involved for a short period of time. I attended a couple of meetings. 09:29AM That case was a follow-on to my work for US EPA on the PCB transport and fate model for the upper Hudson River as part of the RIFS.
Q That work you did for EPA on PCB fate, was that in-stream evaluation you performed in that 09:29AM matter?
A It was in-stream and it also involved some work in the watershed to determine loadings. I can't recall the details right now.
Q Did you do that work on the land runoff or 09:30AM watershed loading work or was that done by someone else on this PCB project?
MR. BOND: Object to the form.
A That was a very large project. It involved the prime contractor. It involved many different 09:30AM subconsultants, many different teams. There were many activities ongoing on the receiving water side and on the land side. I know that we had to determine the PCB loadings from the watershed in order to ensure that our mass balance was complete. 09:30AM

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The context was that the principal source of PCBs to the system, again, was not in question. It was a general electric plant at Hudson Falls. They had released PCBs over some period of time.
Q Was it a stormwater point source-type 09:31AM discharge?
A There were continuous releases over time, as well as increases during periods of stormwater. This was a plant that used very large quantities of -- they didn't manufacture it but they used pure 09:31AM PCB product in the manufacture of capacitors, so there was a very large amount of PCBs at the site. It leaked during -- in between storms and, of course, it also continued to leak and increased during storms. 09:31AM
In our mass balance modeling, we -- again, I would have to consult the reports for details, but we did need to take into account other potential sources of PCBs to the river from the watershed in order to conduct a mass balance model to make sure 09:32AM we captured all the sources.
Q Okay. When you say we, what do you mean by we?
A My project team.
Q Okay. Were you the one on the project team 09:32AM

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that evaluated these other sources of PCBs or is that someone else on the team?
A I didn't personally do it. I evaluated results. I directed methods. I simply can't recall the level of work that was done with watershed 09:32AM loadings either by my team on that project.
Q Was there any watershed modeling performed on PCBs in that project?
A There may have been within the overall project -- within the overall team but not within 09:32AM my -- not within my project team.
Q Okay, but there was no testimony given in that particular project; correct, sir?
A That's correct. There was some thought that perhaps an NRDA assessment would proceed, but 09:33AM apparently that never happened.
Q What's the next litigation support matter you worked on, sir?
A The next one would be litigation support for wastewater treatment plant permit challenge 2004 09:33AM through 2005. I did not provide any sworn testimony. I did prepare one or two declarations in the case.
Q And what were your -- the topics of your declarations in that particular case; is that 09:34AM

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Virginia. There was a federal plaintiff, perhaps U. S. Fish & Wildlife Service, but I'm just not sure.
Q Do you remember what court the case was venued in?
A My recollection is that it would have been federal court in the Southern District of Ohio. 09:41AM
Q What were the chemicals of concern in that case?
A A chemical called thiram. That's T-H-I-R-A-M as in Mary. 09:41AM
Q And how was the chemical of concern discharged; what manner?
A My recollection -- and, again, this goes back some years. I'll tell you what I recollect. One of the metals at the plant was chromium, and a chemical was used to treat chromium before discharge so that it would meet the applicable discharge limits or permit limits, and my recollection is that this chemical transformed. The claim was that this chemical transformed into a different form, a toxic form, and it was discharged in the waste stream from the plant. 09:42AM 09:42AM
Q Was it a point source discharge?
A Yes, it was a point source discharge.
Q Okay, and did you employ any modeling in that 09:42AM

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particular case?
A We did not. The plaintiffs used a hydrodynamic sediment transport and chemical transport and fate model to support their claims, and my job was to review that model and prepare an expert report. 09:43AM
Q And the plaintiff's model in that case was an in-stream model?
A Yes.
Q Okay. What else have you provided expert work on, sir, in a litigation context? 09:43AM
A The second item on this list was -- did not involve any testimony. Would you like me to talk about it?
Q Would you please just briefly, sir, just tell me what the chemicals were -- 09:43AM
A Sure.
Q -- what the issues were in the case.
A There was extensive contamination. The site was in northern New Jersey. It was a site of a former manufactured gas plant. The site was heavily contaminated with PAHs, polyaromatic hydrocarbons, and the issue involved the movement, overland movement, groundwater movement of the chemicals off the site and into a nearby stream, and then 09:44AM 09:44AM

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subsequently to the Atlantic Ocean.
Q And who did you work for in that case?
A I was hired by the defendants who owned the site. I can't remember the name right now.
Q You ever give any testimony in that case? 09:45AM
A No. I --
Q The reason I ask is I notice here it says expert witness services, so --
A Well, I'll describe my services and perhaps -- or perhaps what I mean by expert witness and you mean might be two different things, but I was retained as an expert witness. I conducted investigations of a large number of documents, a large amount of data from the site involving soils, groundwater, contamination in the receiving tributary and data pertaining to overland flow movement of the contamination within the site and off the site, and I presented my findings orally to counsel for the defendants, and my recollection is that the counsel for the defendants thanked me for my services but said that my findings didn't support the direction they wanted to take in the case. I was thanked for my services and paid, and that was the end of it. 09:45AM 09:45AM 09:46AM
Q In that particular case, how did you evaluate 09:46AM

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the overland flow and movement in and off the site?
A We reviewed the data point in time, point in space measurements at the site. We reviewed data in the stream itself. We might have done some flow calculations in the stream. We might have done some overland runoff calculations. I can't remember. We looked at -- there were concentration profiles with depth. We attempted to -- 09:47AM
Q You talking about the depth of the sediments?
A The depth of the soil, right. We attempted to estimate when the chemicals were first deposited, what the rate of deposition might have been and to determine at a very coarse level because of the time history of the contamination, when did it start, what was the rate of increase, and perhaps if monitored natural attenuation were allowed to occur, then perhaps some estimate of how long it would take for this to occur at the site. 09:47AM 09:48AM
Q When you said you looked at the depth, are you talking about sediment depth, the contaminants in the sediment? 09:48AM
A Soils.
Q In soils on the site?
A Soils on the site, correct.
Q Okay.

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A There may have some sediment cores in the receiving stream, but I can't remember.
Q When you said you may have looked at some overland runoff calculations, what calculations did you look at? 09:48AM
A I can't remember whether we reviewed existing reports or whether we conducted some simple calculations. I can't remember.
Q Could you describe what a simple runoff calculation is? 09:49AM
A Universal soil loss equation, if you know something about the solids, the precipitation, the density, I forget what other terms are in that equation, one can make some simple estimates of runoff, for example. 09:49AM
Q That would be runoff from the disposal locations to near a stream?
A That's correct. In the PCB TMDL model that I developed for the Delaware River estuary, I worked in conjunction with the Delaware River Basin 09:50AM Commission. Contaminated sites were an important part -- were an important loading source category, and estimates needed to be made of the runoff of PCBs from these sites, and I believe the universal soils equation was used to make those calculations. 09:50AM

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Q In that particular calculation, does that focus on the -- you gave an example of USLE I think you called it?
A Universal soil loss equation, yes.
Q Does that focus on only erosion of, for 09:50AM example, the soils or does it actually look at some kind of leaching analysis?
A I believe it's just erosion, mobilization of solids.
Q And did you employ a similar methodology in 09:51AM this PCB TMDL you mentioned?
A It was employed. I was not the person who employed it. That was done by the DRBC staff, and I was involved in the review of those results and the use of those results. 09:51AM
Q Was there any -- in either the TMDL study that you mentioned, I think it was the Delaware River; correct?
A Yes, that's correct.
Q Or this particular gas manufacturing plant 09:51AM site, was there any runoff modeling performed?
A Are you asking me about both sites, the Delaware and the --
Q Yes, sir. If you could take them one at a time, I would appreciate that. 09:51AM

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A Yes. Here was runoff modeling. There was non-point source runoff modeling conducted as part of the Delaware River estuary PCB TMDL.
Q And for the gas manufacturing plant site?
A I simply can't recall for sure. 09:52AM
Q Did you prepare a written report on the gas manufacturing plant site?
A No, I did not. I provided an oral report.
Q That's right. You mentioned that. Thank you. On the Delaware PCB TMDL, what runoff modeling was 09:52AM performed in that particular work?
A I don't know what model was used. Again, that was a large project. There were many different players, and my recollection is that the non-point source runoff modeling was conducted by a contractor 09:52AM for the City of Philadelphia, CDM.
Q CDM did the runoff modeling in that case?
A That's correct.
Q So that wasn't your piece of the working, the runoff modeling? 09:53AM
A That's correct, the runoff modeling was not. The piece that I was involved in was the runoff determinations for the contaminated sites. I worked corroboratively with DRCB staff.
Q What was your principal focus in that Delaware 09:53AM

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River PCB TMDL; was it the in-stream portion of the analysis?
A In-stream and sediment.
Q Okay. There's one other one on Page A-2 of your CV I notice. Can you tell us about that 09:53AM litigation work you did there?
A Litigation support for a food processor in the Illinois River watershed. That's this present case.
Q Okay. Can you recall, sir, any other litigation you were involved with as an expert 09:53AM that's not listed here in your CV?
A Let me look at the other portion of my CV that would contain such projects if they were done outside of the last ten years.
Q Please feel free. 09:54AM
A On Page A-9 of my CV --
Q Yes, sir.
A -- the second item from the bottom of the page, litigation support and expert testimony for a major chemical company in Michigan involving NPDES 09:55AM permit violations. That was in 1996.
Q Did you give deposition testimony in that case?
A Yes. I was deposed.
Q Did you give in-court testimony in that case? 09:56AM

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different spatial segments, so the non-point source loadings had to be broken out into different spatial segments.
Q Okay. So how did you route the unit load analysis from the land use to the bay? 10:10AM
A I can't remember whether the non-point source analysis was used just for the direct runoff and we captured the non-point source loading to the tributaries through the tributaries. I'm sorry. It's 25 years ago. I simply can't recall. I know 10:11AM one of the issues was -- let me back up. We wanted to quantify all of the phosphorus load going into Saginaw Bay. Some of the tributaries had adequate data to do this. Some of the tributaries did not have either data or enough data. So I believe -- I 10:11AM believe we used the non-point source calculations for areas where we did not have tributary flow and concentration to compute the loadings. I think that was my recollection.
Q So you look at the outlet of the tributary to 10:12AM the bay and determine the concentration of flow to determine the load from that tributary for that part of the watershed?
A For tributaries, let's talk in specifics. The Saginaw River, there was a station located near the 10:12AM

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delivery point of the Saginaw River to Saginaw Bay, and we had flow data and concentration data, and we used those data to determine the total phosphorus load from Saginaw River to Saginaw Bay. We did that for several other tributaries where there happened 10:12AM to be stations located close to the bay and where they had sufficient flow and concentration data.
Q So where you had data of flow and concentration from the tributary, then you didn't use the spreadsheet coefficient method to determine 10:13AM non-point sources?
A That was my recollection, but I can't be positive.
Q And do you recall how you routed -- for those areas where you didn't have tributary data, how you 10:13AM routed the runoff from the fields with those coefficients to the bay, to the tributaries that are relevant to those particular areas of the watershed?
A I can't recollect exactly, but I'll tell you what I do recollect. If the land area was in a 10:13AM location where there would be direct runoff to the bay, we routed it directly to the bay. If the land area was in a location where it would be routed to a tributary, then to the bay, we routed it to the tributary. That would be a reasonable way to do it. 10:14AM

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I think that's what we did but, again, I can't recall the details.
Q For those areas where you did have observations of the concentration and flow from the tributary, did you use that data to check your 10:14AM analysis on the tributaries where you didn't have such observations to determine whether your coefficients were correct?
A Again, my recollection is not exact, but I believe what we did is if we had an instance where a 10:14AM tributary had flow and concentration data, we computed loads from that tributary using those data, and if a nearby tributary, say, an adjacent tributary, did not have data, and if the land uses were similar, we may have applied a unit load to the 10:15AM unmeasured area to estimate that load. That is my recollection.
Q Did you identify sources of phosphorus to the bay in this project?
A We identified total loads. We identified the 10:15AM load due to point sources. We identified the component due to the difference between total load and point sources, but as part of our project, we didn't break it down to any more detail than that.
Q So when you say you identified the component 10:16AM

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that was the difference between total load and point sources, was that the non-point source component?
A I believe that's what we did. I should tell you that the purpose of my study was to determine the total loadings of phosphorus to the bay and the 10:16AM total loadings -- the total flows to the bay for purposes of driving the in-bay model.
Q Did you do the watershed portion, this analysis we've talked about on runoff coefficients and the stream analysis, or was that done by someone 10:17AM else in your group?
A One of my staff did it.
Q Did you prepare a written report for this case?
A Yes, I did. 10:17AM
Q Do you still have that?
A Yes. Well, not with me, but I'm sure it's in my files.
Q Do you have a copy of the trial transcript for that case of your testimony? 10:17AM
A No, I don't.
Q How about the deposition; was there a deposition taken in that case?
A Two depositions.
Q Do you have a copy of your deposition 10:17AM

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correct?
A That's correct.
Q Okay. It says testified at trial in state circuit court; correct?
A That's correct. Is there -- I thought that's what I was doing, but just for clarity, I wanted to disclose to you that it was before an administrative law judge. 10:32AM
Q Okay.
A So there wouldn't be any mistake in the record. 10:33AM
Q That's fine. I mean, that's our area of expertise, not yours, and so it wasn't before a jury?
A No, it was not. 10:33AM
Q Okay, and your recollection is today that the testimony you gave in that case was before an administrative law judge on a permit-type hearing, for example?
A No. It wasn't a permit-type hearing. The judge actually found for the plaintiffs and fined the chemical company a hundred thousand dollars. So it must have been more than a permit. 10:33AM
Q But you remember him as being an administrative law judge? 10:33AM

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A Well, that's my recollection, but as you point out, that's not my primary area of expertise, and it was 13 years ago so that could be in error.
Q Fair enough. Dr. Bierman, in this case that's currently before the court here in Oklahoma, did you perform your own investigation of sources of phosphorus in the IRW? 10:34AM
A That's a broad question, so I'll answer it by saying that I performed the investigations of sources that I described in my expert report. 10:34AM
Q Okay. The way I read your expert report is that you evaluated other people's work of identifying sources; correct?
A That's correct.
MR. BOND: Object to the form. 10:34AM
Q Okay. So I guess what I'm asking is, you did your own independent evaluation of what the sources of phosphorus are in the IRW?
MR. BOND: Object to the form.
A I'll explain what I did and you'll have to decide how to characterize it. We did, as I described in my expert report, use the LOADEST statistical model to compute total phosphorus and soluble reactive phosphorus loadings at the three USGS stations -- the last three USGS stations above 10:35AM

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Lake Tenkiller. So that involved computation of loadings. If that's what you mean by conducting an independent investigation of sources, we did that, but I'm not sure that's what you mean by your question. 10:36AM
Q Well, when you determined the loadings to Lake Tenkiller, that's what you are referring to in the LOADEST; correct?
A That's correct.
Q Did you determine the sources of the phosphorus that were contained within those loadings? 10:36AM
A But not during determination of those loadings, no. We just determined the loadings at those locations. 10:36AM
Q Did you -- at any time in your report do you specify the sources of phosphorus that are entering Lake Tenkiller?
A I did not conduct as part of this investigation, nor is there in my expert report -- back up. I did not conduct any independent investigation of phosphorus sources, and I believe in my expert report there is -- I do not express any opinions on -- I'll stop there. I think that answers your question. I did not conduct any 10:36AM 10:37AM

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independent investigation of phosphorus sources.
Q Can I ask the same question with regard to bacteria? Did you do any evaluation of sources of bacteria to the waters of the IRW as part of your work in this case? 10:37AM
A No, I did not.
Q The report that's Exhibit 1 before you, sir, does it contain all the opinions that you're prepared to give in this case?
A Yes, it does. 10:37AM
Q Did you do any work or analysis as part of your work in this case that's not contained in your expert report?
A I produced over 124,000 files, which consist -- which contain 197 gigabytes of information. That's my body of work and, of course, not all of that is in this expert report. 10:38AM
Q Yeah. Let me see if I can ask a more specific question. Did you form any opinions -- let me strike this. Did you perform any major analysis or evaluation that's not reflected in your expert report? 10:38AM
A What do you mean by major?
Q Well, let me ask it another way, a more specific question. Did you prepare a water quality 10:38AM

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model for the IRW?
A No, I did not.
Q How about for the Lake Tenkiller?
A No, I did not.
Q Are you aware of any -- 10:39AM
A Excuse me, sir. Let me -- just so there's full disclosure, I did not prepare any. I did investigate the SWAT report, SWAT work done by Dan Storm, and we conducted some investigation of the HSPF model that was originally done by Tetra Tech, 10:39AM and I think some follow-up work had been done by AQUA TERRA, but they were not independent investigations I conducted. They were investigations of others' work.
Q But you reviewed those models? 10:39AM
A I reviewed the work, right.
Q Okay. My question was more directed -- and I appreciate you being complete, Dr. Bierman. I think that's what they always mean when you say to tell the whole truth, and I appreciate that. Did you 10:39AM actually prepare a water quality model, though, for Lake Tenkiller, your own shop prepare your own model?
A No, we did not.
Q And the same for Lake Tenkiller or the rivers; 10:40AM

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correct?
A That's correct.
Q Are you aware of -- have you had a chance to review the other expert reports in this case provided by the defendants? 10:40AM
MR. BOND: Object to the form.
A I have read some of them.
Q Okay. In those reports that you've read, can you recall whether any of the defendants' experts' reports you've read identify sources of phosphorus 10:40AM in the IRW?
MR. BOND: I'm going to object to the form of that question.
A I need to refer to my report, please.
Q Certainly. 10:40AM
A Please repeat the question.
Q I was asking whether or not you were aware of any other expert retained by the defendants in this case that have given an opinion as to sources of phosphorus within the IRW. 10:41AM
A On Page 11 of my expert report --
Q Yes, sir.
A -- last paragraph, I read the expert report by Dr. Ron Jarman, and this last sentence cites land application of biosolids from WWTPs and WWTP 10:42AM

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bypasses and overflows. I cite them -- I state them as sources, and I got that information from Dr. Jarman's report.
Q Okay. Any others that you can identify from the work you reviewed? 10:42AM
A Not that I recall outside of what is contained on Page 11 of my report where I make reference to a number of other published reports which state sources.
Q On Page 11? 10:43AM
A Yes.
Q Could you give me an example other than Dr. Jarman's citation, sir, so I can understand what you are referring to?
A Right. Fourth paragraph, the Comprehensive 10:43AM Basin Management Plan For the Illinois River Basin in Oklahoma by Haraughty 1999. I'm not sure if I'm pronouncing that correctly, but it's spelled H-A-R-A-U-G-H-T-Y. That's a 1999 report that listed the following sources of phosphorus that I have 10:43AM bulleted out underneath that paragraph. That's one example. Another example would be Urban Runoff in Golf Course Fertilizer Application, and those sources are stated in Appendix B of Dr. Engel's report. 10:44AM

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Q Okay. This work by Haraughty, I don't know if I pronounced that right, but it's H-A-R-A-U-G-H-T-Y, were those all the sources that Haraughty identified or was this just some of the sources that you've listed here on Page 11 of your report? 10:44AM
A I can't recall. My intention in supporting Statement 2D was to enumerate all of the other sources, besides poultry litter phosphorus, that I had read about in reports or other expert witness reports. 10:44AM
Q Does Haraughty provide any analysis of relative contribution of these sources of phosphorus?
A I can't recall.
Q Did you do any evaluation yourself, sir, to 10:45AM determine the relative contribution of these sources you've listed on Page 11 to phosphorus in the IRW?
A No, I did not.
Q Dr. Bierman, as part of your work, did you determine how much phosphorus reaches IRW streams 10:45AM from land application of poultry waste?
MR. BOND: Object to the form.
A Did I --
Q Do that evaluation.
A I did not conduct any independent evaluations 10:45AM

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of phosphorus from poultry litter that makes it to rivers and streams in the IRW.
Q I guess the same question for Lake Tenkiller: You didn't do any independent evaluation as to what phosphorus land-applied poultry waste in the IRW reaches Lake Tenkiller? 10:46AM
MR. BOND: Object to the form.
A I did not conduct any independent investigations of the transport or delivery of phosphorus from poultry litter from fields in the IRW to Lake Tenkiller. Is that responsive to your question? 10:46AM
Q Yes, sir, thank you. And, Dr. Bierman, are you providing any opinions in this case, which would characterize the relative contribution of phosphorus from different sources in the IRW, for example, an opinion that cattle contributes more phosphorus than poultry, for example? 10:46AM
A I am not providing that opinion.
Q Or any kind of relative contribution opinion at all? 10:47AM
A I'm not providing any opinions of the relative contribution of poultry litter to phosphorus loads to streams and rivers or to Lake Tenkiller based on any independent investigations I have conducted. 10:47AM

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Q I'm going to ask this question. I know you probably mentioned some of them but I'm going to try to make sure I've got the full scope of your experience the best we can recall today. You've mentioned a couple of cases where you've evaluated non-point source pollution. I think one of them would be Saginaw Bay we recently talked about. I think there was one perhaps with PAHs running off potentials. Other than -- 10:48AM
A Excuse me. The PAH case I did the receiving water model, recall. One of the other experts had done the land site loading determinations in that case. 10:48AM
Q Okay. Other than what we've talked about so far today in your deposition, do you recall any other work where you've done an analysis of non-point source pollution? 10:48AM
A May I refer to my CV?
Q Absolutely, sir.
A Okay. Okay. I'm here. 10:49AM
Q Can you identify the page you're looking at, sir?
A I'm sorry. Page A-6.
Q Thank you, sir.
A I will start with the more recent projects and 10:50AM

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work backward in time.
Q Okay.
A The second project under selected experience --
Q Uh-huh. 10:50AM
A -- Review of Watershed and Water Quality Models For Nutrient TMDLs in the Caloosahatchee River estuary. TMDLs, of course, means total maximum daily loads. The --
Q Please go ahead. 10:50AM
A I conducted an independent scientific review of a coupled watershed receiving water model. The HSPF model, watershed model had been applied to the entire Caloosahatchee River watershed. I assessed the watershed model and the receiving water model. 10:50AM
The issue was nutrients and dissolved oxygen.
Q So the HSPF model was coupled with what other to evaluate the watershed in that case?
A The HSPF model was the watershed engine, loading engine so to speak. The outputs of the HSPF model were used as inputs to the EFDC receiving water model in the estuary. 10:51AM
Q And what did you find in that evaluation?
A Well, I conducted a review of the work and I provided about seven or eight pages of comments. 10:51AM

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This model was put forth by the Florida Department of Environmental Protection for use as the modeling platform to develop nutrient TMDLs for the Caloosahatchee River estuary.
Q Okay, and what was the runoff model that was used on that TMDL analysis? 10:51AM
A Well, HSPF was the -- HSPF is the watershed model, and that includes non-point source runoff.
Q And were you personally the one who evaluated the sufficiency of the HSPF runoff model in that case? 10:52AM
A I was personally involved as was a staff person.
Q Okay, and what evaluations did you perform on the HSPF model for that particular TMDL? 10:52AM
A We evaluated the input data, the site-specific application, the calibration results, comparisons of model output to data.
Q Anything else?
A It's the things that one would -- 10:53AM
Q Did you find that the HSPF model was sufficient to model the watershed loads for that river estuary?
A I need to draw a distinction between HSPF as a modeling tool, a modeling platform, and this 10:53AM

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eight states and District of Columbia, had agreed to establish cap loads on phosphorus, nitrogen and solids for the entire bay to meet water quality standards that involved algae, dissolved oxygen and light attenuation. 11:20AM

Metro Washington Council of Governments -- the constituents would all be affected by whatever these load caps were, and the load caps were broken down by major tributary. So I was hired as -- to conduct an independent scientific review of the models and 11:21AM of the process by which the TMDLs were developed, and the process went on for some years. I attended many meetings of the modeling subcommittee, the water quality steering committee and so on, and basically the models, the watershed and water 11:21AM quality models were run in consecutively many times, perhaps a hundred times or more.

Q Did that particular project involve determining sources of nutrients?

A That was part of it. This was a very large 11:22AM project. It had many moving parts. The --

Q Were you involved in determining sources, sir?

A I was not involved in determining sources.

Q Sometimes if I can just ask a quick follow-up -- 11:22AM

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A Sure.

Q I don't mean to interrupt you but it will cut our --

A Sure.

Q On Page A-9 at the top, there's a reference to 11:22AM Gulf of Mexico Hypoxia Assessment.

A Yes.

Q Did that work involve evaluating sources of nutrients to the Mississippi River basin?

A The overall assessment did. My role, though, 11:23AM was to use the results others had developed for sources.

Q Okay. Dr. Bierman, would you consider yourself a limnologist?

A I would not label myself as a limnologist, but 11:23AM I have considerable knowledge and experience in limnology because of my long experience in developing and applying water quality models.

Q What about a river ecologist; would you label yourself as a river ecologist? 11:23AM

A No, because if you're a biologist and you label yourself as an ecologist, that has a certain meaning. I would not presume to adopt that title to describe myself. I do know -- I have some knowledge of river ecology, sir, but I am not a river 11:24AM

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ecologist.

Q How about a geologist; would you characterize yourself as a geologist?

A I have a working knowledge of geology, but I would not label myself as a geologist. 11:24AM

Q A soil scientist, would you label yourself a soil scientist?

A I have knowledge of soil science, but I would not label myself a soil scientist.

Q Microbiologist, same question? 11:24AM

A Same answer.

Q Fisheries expert?

A Same answer. I know something about -- I have knowledge of fisheries, but I would not characterize myself as a fisheries expert. 11:24AM

Q How about a hydrologist?

A I know a lot about hydrology. I've had courses in hydrology. I would not characterize myself as a hydrologist. If I can offer a sidebar here, normally one would apply the phrase 11:25AM hydrologist to someone who is trained in hydrology, who practices in hydrology, and whose knowledge and practice are by and large limited to hydrology. That is not what I do. I develop and apply models, environmental models, mass balance process-based 11:25AM

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models, and I've done this for many systems, land-based systems, aquatic, rivers, streams, estuaries and so on, and that requires me to have knowledge of many different areas of science and engineering. However, it doesn't require me to be a 11:26AM hydrologist or a river ecologist or any one of these. I guess what I'm saying is my expertise is interdisciplinary and multidisciplinary. So none of the labels you've put forth so far I would use to apply to myself. 11:26AM

Q I understand, sir. What uplands watershed modeling have you personally performed, and I'm not talking about here reviewing someone else's model, but I'm talking about work you've personally done with regard to uplands watershed modeling. 11:26AM

A Please define uplands.

Q That would be runoff from fields or soils runoff as opposed to the in-stream or lake or bay model component.

A By personally performed, do you mean actually 11:27AM running the model hands-on?

Q Yes, sir.

A Well, actually I have as much hands-on experience with Dr. Engel's GLEAMS model of the Illinois River watershed as he claimed to have had 11:27AM

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during his deposition, that is, I've run it perhaps half a dozen times.
Q The GLEAMS model?
A Yes, sir. As Dr. Engel stated in his deposition, he's not the man at the switch running the model every day. 11:28AM
I work in a similar mode. I have 35 years of experience, and I work with highly trained, highly qualified, highly motivated staff on this and many of my other projects. In particular, I've worked with four principal staff on this investigation. 11:28AM
Just the four principal staff I've worked with have a combined total professional experience of 85 years. I have personally worked with these people for 62 years. In addition, there have been three, four, half a dozen other people involved from time to time in this project. I don't work in a vacuum, sir, and neither does Dr. Engel, neither does anyone who has been at 35 years of professional experience in my field. 11:28AM 11:29AM
Q Okay. Well, what I want to do, though, sir, is I want you to tell me about your personal experience throughout 35 years, not today maybe, but throughout your 35 years of experience, how much personally have you done on upland modeling? 11:29AM

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A Are you asking me how many times I've been the man at the switch actually running the model?
Q Yes.
A A small number of times, perhaps a dozen.
Q Okay. Have you published any of your work concerning -- let me strike that. Have you published anything in a peer-reviewed journal that relates to uplands watershed modeling, any papers? 11:29AM
A The paper on the Everglades water quality modeling was published in the journal called Ecological Modeling. 11:30AM
Q Okay, and what runoff model was used in that particular case?
A That was the south Florida -- that was the runoff model that was built on the -- well, it's called the Everglades water quality model actually. Hydraulic portion of it was the so-called two-by-two model. We developed a new model based on that hydraulic foundation, and we added phosphorus and chloride to it and modeled phosphorus and chloride in the overland areas and the canal systems of south Florida, and we named it the Everglades water quality model, and that's what we called it. 11:30AM 11:30AM
Q Any other peer-reviewed journal publications where you've personally done work on runoff 11:30AM

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modeling?
A No. I have several papers published on tributary load estimation using tools that were actually predecessor tools and were later incorporated into LOADEST. I'm not sure that that answers your question, but I'm just disclosing that because it touches on the topic of loadings. 11:32AM
Q Doesn't LOADEST primarily focus on in-stream processes?
A That's correct. 11:32AM
Q I was asking field runoff. Nothing else?
A No.
Q How often have you worked with the GLEAMS model, not including this project?
A The GLEAMS model as a tool or the process-based deterministic mass balance science in GLEAMS? 11:32AM
Q No. I'm talking about the GLEAMS model as a tool.
A Not before this project. 11:33AM
Q What about the SWAT model; how often have you used that model as a tool?
A I have not used SWAT.
Q And HSPF, I think you identified a couple of projects that you worked with it. How often have 11:33AM

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you used the HSPF model?
A I think it was more than a couple of projects. It might have been five or six. The record will show the exact number, but it's more than two. I'm sorry, the rest of the question was? 11:33AM
Q Then I guess my other question, do you recall any other watershed field runoff models that you've worked with other than HSPF?
A Unit area load models.
Q Where you used like the spreadsheet analysis? 11:34AM
A Yes.
Q Okay.
A The Everglades water quality model. That would be it. I should point out that Dr. Engel in his deposition, and I think I agree with him, pointed out that HSPF is a more complex and more sophisticated model than GLEAMS. It is a watershed model as opposed to a field scale model, and it is more complex and sophisticated. 11:34AM
Q I'm going to move to strike as not being responsive to any question. 11:34AM
Dr. Bierman, did you or your group perform any field investigations in the IRW?
MR. BOND: Object to form.
A We did not take samples in the field. I 11:35AM

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did -- I'm not sure if this qualifies but I want to disclose it so I'm giving you a complete answer. I did spend several days in the watershed, and it involved being on the water for several days, the Illinois River, but I did not take any samples. 11:35AM

Q Or perform any scientific analysis other than your visual observations?

MR. BOND: Object to form.

A Well, okay. Let's go back to square one. I have not -- neither myself nor my team has conducted 11:35AM any sampling in the Illinois River watershed. My personal experience -- my -- I did visit for several days and observe. We made observations at numerous points in the watershed and on the water itself. That was an observational trip only. 11:36AM

Q Okay. When you say -- let me back up here. How many days have you been in the IRW where you've actually done observation work?

A I guess it depends on how you count. I visited Fayetteville a number of times, but I was 11:36AM out in the -- this trip lasted -- it was about two years ago. I can't remember. I think it was three or four days.

Q I'm not talking about when you were visiting an office in Fayetteville. 11:36AM

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A No, no. Out in the field -- we were out in the field for three or four days, myself and some of the other defendants' expert witnesses.

Q And that was two years ago?

A I think it was in summer of 2006 actually. 11:37AM

Q Any other field work you've done in the IRW?

A No.

Q What observations did you make when you were out in the field?

A Well, it's a broad question. I made many 11:37AM observations over four days and there were many pictures that we took.

Q Did you produce all your photographs?

A Yes.

Q So what did you do? I'm just trying to 11:37AM understand what you did for three or four days within the Illinois River watershed.

A Part of it involved driving to different sites. Well, back up. The question is broad. I'll try to be responsive, and if you want more detail, 11:38AM I'll need to refer to my photographs. I observed pastures. I observed poultry houses. I observed -- I think we observed at one point a wastewater treatment plant. We observed the large nursery on the shore of Lake Tenkiller. We observed eroded 11:38AM

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stream banks. I observed cattle in the riparian zone. I observed cattle in the stream. I observed cattle defecating in the stream, things of that nature.

Q Did you notice any filamentous green algae in 11:38AM the streams?

A I observed algae in the stream. I didn't know if they were filamentous green algae or not. One would need to have taken a sample and looked under a microscope to confirm the algal identification to 11:39AM give an exact answer to your question, and I did not do that. So I may have observed it in the sense that I may have seen it, but I didn't know necessarily if it was filamentous green algae.

Q Did you see any algae attached to rocks on the 11:39AM streambeds or the sides of the stream?

A Yes.

Q Did you observe any poultry waste land applied in the IRW when you were out there?

MR. BOND: Object to form. 11:40AM

A Did I observe the application process?

Q Yes, sir.

A I don't recall that I observed that. I could have, but I can't remember.

Q Do you know how poultry litter is applied in 11:40AM

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the IRW?

A I've read about how it's applied, but I can't recall the details sitting here.

Q You didn't do any study of poultry litter application in the IRW, how it's applied, when it's 11:40AM applied?

A I did not conduct independent studies of those things.

Q You reviewed what Dr. Engel -- analysis, for example? 11:40AM

A Well, I read Dr. Engel's report. I also read reports by other of the plaintiff's experts, and I've read some of the reports of the defendants' experts, and I'm sure I've read descriptions of that operation, but I don't recall the details. 11:41AM

Q Are you offering any opinions concerning the methods of poultry litter application in the IRW?

A The methods?

Q Yeah.

A No, I'm not. 11:41AM

Q Or the timing?

A Only insofar to point out, as I did in my expert report, that Dr. Engel's model represents all the poultry litter as being applied once a year in a single heap. Whereas, data in another portion of 11:41AM

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waste storage lagoons.
Q Okay. Do you agree with that statement, sir?
MR. BOND: Object to form.
A From agricultural lands? Well, as a broad general statement, qualified by the words primarily, I don't have a disagreement with that part of it as a broad statement but, again, it depends on what happens in any particular site or watershed can be very different. I don't frankly understand as well as by direct discharges from animal waste storage lagoons. I suppose that could be a potential source, but I would not sit here and agree that that is one of the primary sources. 01:16PM
Q What; the discharges from animal waste storage lagoons? 01:17PM
A Yes. I'm not familiar enough with discharges from animal waste storage lagoons to express an opinion about that part of that sentence.
Q What evaluation have you done to determine that the transport of phosphorus from runoff varies from watershed to watershed? 01:17PM
MR. BOND: Object to form.
A What analysis have I done --
Q Yes.
A -- or what scientific literature and reports, 01:17PM

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what am I familiar with? Is it --
Q Let's start with first your analysis and then we'll go to the second.
A I've done quite a bit of work in the Lake Okeechobee watershed, and I know the characteristics of the soils and the topography of the land in south Florida, especially the Everglades agricultural area, are quite different from agricultural areas, say, in the upper Midwest. 01:18PM
Q Okay. Have you done any evaluation to determine whether it affects runoff from manures being applied to those lands? 01:18PM
A I have not conducted any of those evaluations, no.
Q Have you reviewed literature concerning those issues, sir? 01:18PM
A Concerning the issues of --
Q Of runoff from agricultural lands where manure has been applied.
A I've reviewed many papers and reports which contain that information, but I have not specifically done a literature search or survey directed at that particular topic. 01:18PM
Q Okay. Let's skip the next sentence and read the next two after that where it starts the amount 01:19PM

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required.
A The amount required for crop production is determined by a variety of soil extraction procedures that measure plant available P, in quotes. 01:19PM
Q And the next sentence, sir?
A When available P levels at the soil surface exceed threshold levels at which there is no further response by the crop, in parens, Sharpley, et al, 1994, the potential for P losses to surface waters increases. 01:19PM
Q Do you agree with that statement, sir?
MR. BOND: Object to form.
A Well, this appears to be a statement based on the Sharpley, et al, paper, 1994, and sitting -- I'm not familiar with that paper. I don't have any reason to disagree with this statement, but I certainly would not want to be in a position of expressing an opinion about whether I would agree with it because I've not conducted any detailed investigations of this topic. 01:20PM
Q Have you conducted any investigations of the relationship between the phosphorus concentration in the soil and whether or not that will affect the runoff of phosphorus from that soil? 01:20PM

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A Again, I've read papers and reports, but I have not conducted my own independent investigations directed at that topic.
Q Okay, and those papers that you reviewed, do they agree that as phosphorus concentrations of soils increase, all things being equal, that runoff from those soils, phosphorus, increases? 01:21PM
MR. BOND: Object to form.
A It's my recollection from reading these papers and reports that if there's more phosphorus in the soil, then it's more likely that runoff will occur during a precipitation event. I think that's just consistent with common sense. I have no reason to disagree with it. 01:21PM
Q Have you studied any reports, sir, concerning phosphorus concentrations in the upper Midwest as relating to fertilizer and manure applications? 01:22PM
A Again, I'm sure that I've read reports -- I've read reports or papers that describe that but I have not studied it in any detail. 01:22PM
Q Have you investigated any reports within the Illinois River watershed concerning the increase of phosphorus concentrations in soils over time?
A I can't recall reading specific reports addressing phosphorus increases over time. I've 01:22PM

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models, did they do that evaluation to identify sources of contaminants in waterways?
A I've seen it used for contaminants; I've seen it used for nutrients.
Q Okay. In the NOAA work that you were a part of, did the investigator for sources in the NOAA work employ a mass balance approach to determine sources of nutrients in that study? 02:08PM
A My recollection of the work done that Goolsby did in the Task 1 report, and I believe that's the report in which the loadings were done, he did use mass balance, among other -- I believe he did include mass balance as one of his approaches. However, what Dr. Goolsby did was identified sources on the land and explicitly looked at the delivery of those sources to the receiving water streams, and as part of the overall study, those loadings were delivered to the Gulf of Mexico, the point being that there was -- that study involved the explicit addressing of loads moving from land to water and then from the stream and river network to the Gulf of Mexico, which was really the ultimate objective of that study. 02:09PM 02:10PM
Q Does Dr. Goolsby, when he looked at those transfers from the watershed of the mass balance 02:10PM

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into the streams, did he use runoff coefficients --
A I don't recall --
Q -- of non-point sources?
A I don't recall what he did. It was ten years ago, and I certainly don't, sitting here, have a detailed knowledge of his method, and I'm not going to speculate on what he did. 02:10PM
Q Did you do any study to determine whether or not the mass balance results that Dr. Engel performed were related to the sources of phosphorus found in the rivers and streams of the IRW? 02:10PM
A If you're asking did I conduct an independent analysis of sources?
Q And to see whether or not there was a relationship between what Dr. Engel found with his mass balance study and the sources that were in the IRW streams. 02:11PM
A I did not conduct any independent analysis to investigate the individual sources that Dr. Engel included in his mass balance. I simply reviewed what he had done, and I put forth this opinion about his results. 02:11PM
Q Would you read the last sentence on the second paragraph, first full paragraph at the top of 4 that says this claim? 02:11PM

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A Yes.
Q Would you read that for the Record, please?
A This claim is based on Dr. Engel's phosphorus mass balance and is a completely misleading representation of the relative contribution of poultry litter phosphorus to water quality impacts in the IRW. 02:12PM
Q Okay. If you didn't do your own study to determine what the relative contributions are of poultry litter versus other contributions, what's your basis for that particular statement? 02:12PM
A Actually it's just common sense because the only way that water quality, that is, water quality in streams and rivers in the IRW or in Lake Tenkiller, could be impacted by phosphorus loadings is if one explicitly considers the loading of phosphorus from sources based on land to the receiving streams and rivers or to Lake Tenkiller, and Dr. Engel's mass balance in Appendix B of his report simply did not do that. 02:12PM 02:13PM
Q On the next paragraph, the middle of the paragraph, let me read, from materials produced by Dr. Engel, the total phosphorus mass in the IRW soil in his GLEAMS model is 6,370,989 tons. This reservoir represents the sum of phosphorus mass for 02:13PM

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actual conditions, 1997 to 2006, in all horizons, layers in his GLEAMS model. The bottom depth of these soil horizons range from 15.24 to 83.93 inches, depending on location, and then you go on to say that the poultry contribution would only represent .07 percent of this total phosphorus mass; correct; is that essentially what -- 02:13PM
A Well, I said what I said, and you read. Of course, I wrote what you read.
Q Okay. How much of this total phosphorus mass is actually available for runoff that you've calculated here in the 6,370,998 tons? 02:14PM
A I don't know because I didn't conduct that investigation.
Q Is it generally true, sir, that the phosphorus that would be contained in the upper, say, two inches of the highest horizon of the soil would be more susceptible to runoff than something that's a meter below ground surface? 02:14PM
A I wouldn't put a number to it of two to four or two to six inches, but I would agree that phosphorus that is closer to the surface is more likely to run off than phosphorus at deeper layers. 02:14PM
Q Your analysis included even the deeper layers, did it not? 02:14PM

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such as phase partitioning and precipitation.
Q Are most of them different?
A I wouldn't say most. Some of them are different.
Q Which ones are different? 02:40PM
A If a molecule of phosphorus is attached to a soil particle in a field and if precipitation occurs and if other conditions are met, such as the cohesiveness, the intensity, frequency, duration of rainfall and so on, a potential consequence is that 02:40PM that soil particle can move, and if it moves far enough, it will leave the field and enter a receiving water body. That sequence of steps I just described happens in a field. It doesn't happen in the water column of Lake Tenkiller. 02:40PM
Q Any other differences?
A Well, there probably are. Again, it depends on the level of detail. I guess that to me there are more similarities than difference because they are finite element process-based mass balance 02:41PM models.
Q Was the GLEAMS model used by itself to model the watershed?
A Dr. Engel used the GLEAMS model by itself to compute phosphorus loadings to edge of field. He 02:41PM

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then, using independent information, added wastewater treatment plant phosphorus loads to those edge of field loads to compute the total load to the river and stream system for each of the three subwatersheds in the Illinois River basin. He then 02:41PM used what he called a writing model to -- we use the route is his word that phosphorus to the USGS stations at Tahlequah, Baron Fork and Caney Creek.
Q Have you ever used an empirical model?
A Yes. 02:42PM
Q Have you ever used an empirical routing model?
A I wouldn't use the term empirical routing model. That's Dr. Engel's description of the model he developed. That is not a commonly-accepted term that has general meaning in the environmental 02:42PM modeling community. I've used empirical. I've used LOADEST. That's a statistical model. In fact, I believe in Dr. Engel's expert report he draws a parallel, a comparison between the LOADEST statistical model and his routing model. 02:42PM
Q Have you used empirical equations for routing in your modeling work?
A I don't recall using empirical routing equations in the way that Dr. Engel has used empirical routing equations. Dr. Engel -- my 02:43PM

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understanding of what --
Q That answers my question, sir. If you don't recall doing it, that's good. Thank you.
MR. BOND: Did you want to explain further?
A Well, I would like to explain further. 02:43PM
MR. PAGE: Well, then you can ask him a question on cross examination. He answered my question.
VIDEOGRAPHER: Can we stop for a second? I think something just happened. All my system just shut down.
MS. LLOYD: I lost power, too.
MR. PAGE: Let's go off the Record.
(Whereupon, a discussion was held off the Record.) 02:44PM
VIDEOGRAPHER: We are now back on the Record. The time is 2:45 p.m.
Q Okay. Dr. Bierman, does the SWAT model use the same nutrient runoff criteria back -- as the GLEAMS model, that is, did the SWAT model borrow the 02:45PM GLEAMS nutrient runoff analysis for its model?
A I know that the science underlying GLEAMS is the same as the science underlying SWAT, but whether or not the specific runoff, was it a coefficient or process that you referred to is the same as GLEAMS, 02:45PM

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sitting here now I don't know that.
Q Does SWAT add to those runoff coefficients that uses a routing method?
A My understanding of SWAT is that it is a watershed model, not a field scale model. So, 02:45PM therefore, it contains in the modeling framework a -- I won't call it a routing model it but it contains -- it explicitly represents the stream delivery.
Q Have you worked with a SWAT model before? 02:46PM
A No, I've not.
Q Are you familiar with the ADAPT, A-D-A-P-T, model?
A No, I'm not.
Q Are you familiar with EPIC, E-P-I-C, model? 02:46PM
A Vaguely.
Q Do you know what kind of a model it is?
A It's a runoff model of some type.
Q And does it add to it a routing component so it can be used on a watershed scale? 02:46PM
A I don't know.
Q Does the SWAT model to your knowledge, sir, use the HRU concept?
A I don't -- based upon my review of the SWAT model applied to the Illinois River watershed by Dr. 02:46PM

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Dan Storm, I'm not sure if he calls them HRUs or some other terms but he does discretize the watershed into different physical areas.
Q What is an HRU?
A It means hydrological response unit. In Dr. Engel's GLEAMS model, it represents land use areas, soil types, rain gauge areas and loading zones. Those were the criteria that he used to construct the HRUs. 02:46PM
Q And does the SWAT model have a similar construct? 02:47PM
A I believe it has a similar construct, but I can't speak to the details of SWAT.
Q Do other runoff models have similar constructs, that is, HRU constructs? 02:47PM
A Different models use different terms. HSPF breaks a watershed into different physical portions. I think they used the term subwatersheds, not HRUs. So there's partly a terminology difference. No two models do it exactly the same way, and no two models necessarily use the same terminology but, you know, what they all do is they balance water and they balance mass relative to the geographical areas that they define. The science is the same. 02:48PM
Q Those characteristics that Dr. Engel -- that 02:48PM

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you just read from your report that characterize HRUs in the GLEAMS model --
A Yes.
Q -- are those same characteristics that are used to distinguish soil compartments or geographical compartments in the HSPF model? 02:48PM
A HSPF does look at land use areas, soil types. It can use rain gauge areas. It may or may not use loading zones. Loading zones is a term that Dr. Engel used to describe the approach he used to specify a rate of application of poultry litter and other animal manures. He could have called it something else. He could have had fewer zones. He could have had more zones. There's some arbitrariness with respect to how that was constructed in his model. 02:49PM
Q Or was it based on Dr. Engel's professional judgment?
A Well, I suppose so. I didn't mean to say he did something arbitrary. I'm trying to point out that the GLEAMS allows the user to make those site-specific judgments in developing and applying a model to a specific site. It's not like it has so many compartments that one needs to fill. 02:49PM
Q Did you review those judgments employed by Dr. 02:49PM

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Engel in this case?
A We did investigate many of his files, which contained information on land use areas, soil types, rain gauge areas and loading zones. We investigated them, yes. 02:50PM
Q I mean, the HRUs in particular.
A The HRUs, we investigated -- we did look at the HRUs, yes.
Q Did you determine whether or not any of the HRU classifications by Dr. Engel were inappropriate? 02:50PM
A It depends what we mean by classifications are inappropriate. It was not inappropriate in my opinion to use, for example, a pastureland use category. It was not inappropriate to use a forest land use category or crop or urban. The -- so in concept, those were not inappropriate. In terms of application, my expert report points out a number of instances where errors were made and the errors -- areas were not represented correctly or pastureland was supposed to be pastureland. It was represented as urban land or something else, so -- 02:50PM 02:51PM
Q We're going to get to those. I did notice that in your report, sir. Other than those misclassifications of land use that you identified, can you think of any other criticism of Dr. Engel's 02:51PM

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use of the -- or how he used the HRU concept in his model?
A For one example, the -- there seems to be an issue over GLEAMS being a field scale model and its appropriateness for use at the watershed scale. GLEAMS is -- the predecessor model to GLEAMS is called CREAMS, and that would be C-R-E-A-M-S. I'm sorry, I don't know what those letters stand for, but it's the same science, and the CREAMS user manual is authored by the same principal author as the GLEAMS manual. I don't know how to pronounce it. It's a Mr. K-N-I-S-E-L, Knisel. In the CREAMS manual, it addresses specifically the question of -- and CREAMS is a field scale model as is GLEAMS. In the CREAMS manual, the specific question of what's a field is addressed, and the guidance in the manual refers to the size of the field being either -- and, again, everything depends on context, everything depends on site. Everything depends on circumstances. There is no one size fits all to this, but the CREAMS manual is explicit in noting that in certain instances a field size can be a few acres. In other instances, it can be a few tens of acres. In other instances, it can be up to a few hundred acres, but it does not allow to how it can 02:52PM 02:52PM 02:53PM 02:53PM

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which each component does and how they're linked. I just know what I've read.
Q Are you familiar with the Manning's equation?
A Yes.
Q Okay. What is that? 03:48PM
A In simple terms, water flows downhill, and if one knows the size and shape of the channel and a friction coefficient, one can use it to estimate velocity of the water flow.
Q So is that the routing equation that was used 03:48PM in this particular watershed analysis?
A Well, it says that's what they did. Again, I just know what I read. I've not read the entire paper; I've not reviewed the paper.
Q On Page 5, sir -- 03:49PM
A Of my expert report?
Q Yes. Thank you, Dr. Bierman. The third paragraph --
A Yes.
Q -- you are talking about the total area of the 03:49PM IRW?
A Yes.
Q And you mention the HRUs, correct, in that paragraph?
A Yes. 03:49PM

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Q And the statements there says, these areas, I guess referring to the HRUs, are much too large to accurately represent local conditions that influence non-point source runoff of phosphorus to edges of individual fields. Did I read that correctly, sir? 03:50PM
A Yes.
Q Okay. What did you do to determine whether or not the HRUs, as selected by Dr. Engel, were too large to accurately represent local conditions?
A One thing I did was to reference Figure 1, 03:50PM which shows that the sediment delivery within a 99,148-acre drainage area could range over approximately a factor of four. What that means is that a phosphorus delivery from a field that large to edge of field depends on the location of the 03:51PM phosphorus. If it's in the middle of the field versus near the edge, the runoff coefficient and, hence, the probability that that phosphorus will run off to the edge of field is very different depending on the location in the field. 03:51PM
In Dr. Engel's model with his HRUs, a pound of phosphorus eroded from the middle of his 99,140-acre pastureland has the same probability of delivery to a stream or river as a pound of phosphorus eroded from near the edge. This is not physically 03:51PM

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realistic.
Q Did you do any evaluation to determine if your concern actually did have an impact on the accuracy of the IRW model prepared by Dr. Engel?
A No, it wasn't my job to correct or redo Dr. 03:52PM Engel's work. It was my job to review it and criticize it.
Q Why is sediment delivery important to this phosphorus model that Dr. Engel put together?
A Because it's -- phosphorus sticks to things. 03:52PM It's well known that phosphorus sticks to solids. If a precipitation event occurs and mobilizes solids and solids are eroded, the phosphorus goes with it. So sediment transport and phosphorus transport are very tightly coupled. 03:52PM
Q Did you review any of the actual data in this case to determine what portion of the phosphorus leaving land-applied fields is associated with sediments as opposed to dissolved phase?
A No, I don't. 03:53PM
Q So you don't know exactly how important sediment delivery is for phosphorus in this watershed, do you?
MR. BOND: Object to form.
A I disagree with that, and I'll explain why I 03:53PM

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disagree with it. I didn't personally conduct such investigations, but other investigators have done so. So on Page 23 of my expert report, for example, I reference a USGS report by Terrio, 2006 entitled Concentrations, Fluxes and Yields of Nitrogen, 03:54PM Phosphorus and Suspended Sediment in the Illinois River Basin 1996 through 2000, and I've excerpted a statement from that report on Page 7, which states that phosphorus is generally transported to surface water bodies through overland runoff and in 03:55PM association with sediment particles and that many elements and compounds, including some forms of nitrogen and phosphorus, absorb to sediment particles and are transported and deposited with the sediment. On Page 38 it goes on to state that the 03:55PM general correspondence between suspended sediment flux and stream flow is expected in most watersheds and particularly in those with agricultural areas where sediment is transported through overland runoff, bank erosion and the resuspension of benthic 03:55PM sediments during periods of precipitation and increased stream velocity. So this was taken from a report on the specific site by a USGS investigator. That is part of my basis for making the statement.
Q What specific site? 03:55PM

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today could be better than what I remembered it, but basically what happens is that a water sample -- the same would be applicable with a soil sample. A sample would be taken partly because the phosphorus is bound, much of it is bound to solid materials. A digestion process occurs, usually an acid digestion process to liberate the attached phosphorus to detach it from solids so that it all becomes -- enters the dissolved phase, and then a colorimetric test is applied which -- in which the color is proportional to the dissolved phase concentration. 04:08PM

Q And so when you look at total phosphorus results, would that -- if the water contained any suspended sediments that had run off from a field, for example, would that total phosphorus analysis include the portion of phosphorus that's attached to suspended sediments? 04:09PM

A It depends on -- it would -- there are many different methods for analyzing phosphorus. I think the handbook, Standard Methods, contains 30 to 50 methods for phosphorus. I'm not familiar with all of them. There are methods designed to measure total phosphorus that involve sample processing, preparation and digestion steps, which would provide an accurate measure of total phosphorus in the 04:09PM 04:10PM

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sample, even the phosphorus that had been attached to solids, if the digestion is sufficiently aggressive and proceeds to completion.

Q The methods that analyze total phosphorus that Dr. Engel used for his model, were those methods sufficient to account for the phosphorus that would be attached to sediment particles? 04:10PM

A I'm not aware that Dr. Engel used any method to analyze phosphorus. I believe he used data provided by others. 04:10PM

Q Okay. Those -- that data and those analyses that are represented in that data, were they sufficient to account for phosphorus that's a part of suspended sediments?

A Your question also pertains to soluble phosphorus and, again, it included soluble -- 04:10PM

Q My question asked you specifically, sir, and if you don't, you can just say you don't know. Were the methods of total phosphorus that were used to provide the total phosphorus information that Dr. Engel used for his analysis, were they sufficient to account for phosphorus attached to suspended sediments? 04:11PM

A Those results were reported as total phosphorus, and my best understanding is that, yes, 04:11PM

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those methods captured all of the phosphorus in a water sample, including the phosphorus that would have been attached to solids.

Q Well, middle of Page 5, sir, of your report, there's a paragraph that says the land use areas in the IRW. Would you read that short paragraph, please? 04:11PM

A Yes. The land use areas in the IRW, to which Dr. Engel applied his GLEAMS model, are too large to accurately represent non-point source runoff from local sources. 04:11PM

Q Okay. Let me ask you a question. Did you perform any tests, sensitivity analysis or otherwise, to determine whether that statement is true? 04:12PM

A Did I perform any tests?

Q Yes.

A No, I didn't perform any tests.

Q Would you read the next sentence, please?

A His large areas do not accurately represent the hydrology, soils and topography of the fields from which these loads actually originate. 04:12PM

Q Okay. Did you perform any tests, sensitivity or otherwise, to determine whether that statement is accurate? 04:12PM

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A No, I didn't need to do that because when I see an HRU that's 99,148 acres, common sense tells me that an HRU of that size cannot accurately represent all of the local variability in hydrology, soils and topography of the many, many different individual fields within an area that large. 04:12PM

Q But you didn't perform any tests to confirm what you refer to as your common sense analysis; that is, you didn't go in and apply a different structure of HRUs to the Engel model to determine whether the results would be different? 04:13PM

A No, I didn't do that because it was my job to critique what Dr. Engel had done, not to correct it or do it over.

Q The two paragraphs below that, it begins another limitation of GLEAMS with its application is that it has no capabilities for representing phosphorus loads from wastewater treatment plants. How did Dr. Engel -- well, first of all, did Dr. Engel represent wastewater tempt plant contributions to the stream loadings? 04:13PM

A He represented wastewater treatment plant loadings to the stream and river network, yes, but he did it outside of the GLEAMS model.

Q And you have employed a similar approach when 04:13PM

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you were evaluating loadings in other watersheds, have you not, where you just looked at the monitoring data and calculated contributions from wastewater treatment plants using monitoring data and loads? 04:14PM

A I specified loads by using the primary flow and concentration data at the tributary mouth, which included non-point source loads and point source loads. If I then asked the separate question, how much of that load might be from point sources, I 04:14PM would separately calculate how much of a total P load was from point sources, but the loads themselves that I put into my models would be the total loads.

Q Okay. Have you ever separately calculated 04:14PM wastewater treatment plant contributions in any of the modeling work you've done?

A Have I ever separately calculated them for inputs?

Q Yes, sir. 04:15PM

A I've separately accounted for them.

Q Have you separately calculated them?

A Have I separately calculated them?

Q Uh-huh.

A I've used independent information and 04:15PM

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accounted for them.

Q What information was that?

A My point here --

Q Could you just answer my question, sir?

A Please repeat the question.

(Whereupon, the court reporter read back the previous questions and answers from Page 210, Line 15 to Page 211, Line 2.)

A I've not used -- I've not separately determined wastewater treatment plant loads and 04:16PM added them to non-point source loads to form total loads in the way that Dr. Engel did it, and the reason is that one can simply -- if I'm interested, for example, in the total phosphorus loads from the Saginaw River to Saginaw Bay, some of that load is 04:16PM from point sources; some of that load is from non-point sources. If I determined the non-point source load separately and if I then add up all the point sources in the watershed, I cannot simply add those non-point sources -- excuse me, I cannot 04:17PM simply add those wastewater treatment plant loads to the non-point sources because wastewater treatment plants are distributed spatially, and I cannot assume that there would be 100 percent delivery of all the phosphorus from each wastewater treatment 04:17PM

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plant to the receiving water body, in this case the Saginaw Bay.

Q I'm sorry. I was going to ask you then, how did you account for, in that situation, the relative contributions in a wastewater treatment plant versus 04:17PM a non-point source?

A For purposes of -- I didn't do that for purposes of providing loadings to a water quality model because that would not have been completely correct. There are two ways to do it, and it 04:17PM depends on the data. There are several ways to do it, and it depends on the data, it depends on the time, it depends on the budget and it depends on the objectives of the study. One way to back it out would be to take the total loads and subtract point 04:18PM sources from it and assume the rest is non-point sources. That method produces a result. It's not necessarily a completely accurate method because it doesn't take into account potential differences in delivery. 04:18PM

Another way to do it would be to apply a watershed model to actually apply -- to do what they do in the Chesapeake Bay, for example, with HSPF. That model computes non-point source loadings of phosphorus, for example, among other things. It 04:18PM

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also adds in separately the wastewater treatment plant loads, but it does so with a geographic context and it adds these loads in, distributed in space at the actual locations of the discharge and, hence, the transport and fate component of HSPF 04:19PM takes care of and represents accurately the transport, fate, attenuation and processing as it's delivered through the stream and river network. That's not what Dr. Engel did.

What Dr. Engel did is added up the wastewater 04:19PM treatment plant loads and specified them directly to the -- added them to the output of his GLEAMS non-point source model and ignored the delivery locations and any transport, fate or processing of those non-point source loads along the way. 04:19PM

Q With Dr. Engel's methodology, did he assume that all the wastewater treatment plant discharge phosphorus made it to the lake?

A He assumed it made it directly to the stream and river network in each of the three 04:20PM subwatersheds. In his deposition he stated that he then assumed that all of the wastewater treatment plant was delivered to Lake Tenkiller in each of the three subwatersheds.

Q So based on your in-stream work, do you think 04:20PM

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Dr. Engel overstated the amount of phosphorus contributions to Lake Tenkiller from wastewater treatment plant discharges?
A Please repeat the question.
(Whereupon, the court reporter read back the previous question.) 04:20PM
A I did not independently investigate whether the delivery of the wastewater treatment plant phosphorus discharges to Lake Tenkiller was overestimated or underestimated. I would have had to conduct my own modeling investigation or correct or do over or fix. However -- please let me continue -- Dr. Engel stated in his deposition that he assumed that all of the wastewater treatment plant loads that he specified and delivered to the stream and river network made it to or were delivered to Lake Tenkiller. I interpret that as being 100 percent delivery. In the real world, 100 percent delivery is simply not realistic. Although I've not conducted a site-specific investigation of this site and his modeling results in that regard, the concept of 100 percent delivery of any phosphorus load over distances of up to 100 miles is simply not consistent with the state of the science. 04:21PM 04:22PM
Q So do you agree, sir, based on that premise 04:22PM

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that you just stated, that, if anything, Dr. Engel overstated the amount of wastewater treatment plant contribution of phosphorus to Lake Tenkiller?
MR. BOND: Object to the form.
A Not necessarily because the same assumptions that he made for delivery -- as I understand his work, the -- his delivery of non-point source phosphorus loading was the same as the delivery of point source phosphorus loading because what he did is the results of his GLEAMS model were phosphorus loads to edge of field. He added to those phosphorus -- those GLEAMS loadings the non-point source loadings and formed a quantity called P to river, and that P to river was routed through what he called his routing model to the three stations. So it was not as though the wastewater treatment plant was routed separately and the non-point sources were routed separately. They were routed together because they were added before the routing. 04:22PM 04:23PM
Q So based on Dr. Engel's analysis then, he treated wastewater treatment plant phosphorus in the same way in his routing model as the non-point source phosphorus? 04:23PM
A Not exactly. His routing model doesn't know the difference between wastewater treatment plant 04:23PM

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phosphorus and non-point source phosphorus. What I said or what I intended to say is that the input to Dr. Engel's routing model consisted of the sum of the non-point source loads computed by GLEAMS and the wastewater treatment plant loads, and at that point there ceased to be a difference between the two, and all the routing model knew is that it was processing total phosphorus. 04:24PM
Q Do you know whether or not in the Illinois River basin phosphorus coming from non-point sources interacts differently in the rivers and streams than phosphorus being discharged from wastewater treatment plants? 04:24PM
MR. BOND: Object to the form.
A That's a question with many parts. There would probably be differences in the transport, fate and attenuation of phosphorus from wastewater treatment plants as compared to phosphorus that might have run off of a field. 04:24PM
Q What's your basis for that statement? 04:25PM
A Because probably -- and I've not conducted a detailed investigation of this. The basis for my statement is that probably the ratios of dissolved particulate phosphorus would be different in these two types of sources because phosphorus is extremely 04:25PM

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complex, and it's unlikely that phosphorus loads from different sources would have exactly the same chemical composition, exactly the same phase distribution and exactly the same chemical properties. Therefore, I would expect there to be some differences. However, I should also point out that Dr. Engel's model doesn't see any of this. His GLEAMS model sees only outputs total phosphorus. His routing model only sees total phosphorus. It does not see any individual forms. 04:25PM 04:26PM
Q In your experience, sir, how does dissolved phosphorus transport differently than particulate forms of phosphorus?
A It's not necessarily that it transports differently. Some forms of dissolved phosphorus, for example, soluble reactive phosphorus, can be taken up by algae and assume particulate form. Whereas, particulate phosphorus, say, a molecule of phosphorus attached to a soil particle, is not immediately available for algal uptake. So the fate -- the physical, chemical and biological fate processes for phosphorus discharged in that form would be different. 04:26PM
Q But doesn't eventually all the phosphorus that is discharged in the rivers and streams of the IRW 04:27PM

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Water Assessment Tool: Historical Development, Applications and Future Research Directions, and it's senior authored by P. C. Gassman, G-A-S-S-M-A-N.

Q Is it your understanding that SWAT uses the GLEAMS and CREAMS runoff components for its model? 05:00PM

A I'm sure some of the detailed components are different, but as Dr. Engel stated in his deposition, the science underlying SWAT is the same as the science which underlies GLEAMS. 05:00PM

Q And do you know whether or not GLEAMS had any special component for urban runoff -- excuse me, not GLEAMS, but SWAT had any special component in addition to what it obtained from CREAMS and GLEAMS to model urban runoff? 05:01PM

A I don't know.

Q Is SWAT used for urban runoff?

A Dan Storm in his application of SWAT to the Illinois River watershed included urban land use, so I know he applied it to urban land use. 05:01PM

Q Do you know whether or not it is typically applied to urban runoff, that is, SWAT?

A I don't know that for a fact.

Q Have you ever reviewed Exhibit No. 10?

A No, I have not. 05:01PM

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Q I assume, sir, when I asked you whether you performed any scientific investigations relating to urban runoff, you also haven't published any peer-reviewed papers relating to nutrient contributions from urban runoff, have you, sir? 05:02PM

A I've not published any papers specifically directed at urban runoff, no. I've published modeling papers in which the -- strike that. That's -- I'll stay with that answer to your question. 05:02PM

Q Let's turn to Page 6 of your report, Dr. Bierman.

A I'm sorry, what page?

Q Excuse me. Page 6.

A Oh, of my report. Sorry. 05:03PM

Q Yes, of your report, sir, Exhibit 1 to the deposition.

A Yes, here we go.

Q Would you read supporting statement 1C that's located on that? 05:03PM

A Yes. The phosphorus routing model developed by Dr. Engel is not a valid representation of the real system of streams and rivers in the IRW and is an inappropriate tool for predicting delivery of phosphorus loads to Lake Tenkiller. 05:03PM

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Q Okay. Did you perform any tests or analysis to demonstrate the truth of that statement?

A Actually I did. The results of those tests are included under Opinion 3, supporting statement A in my expert report. 05:04PM

Q Okay. Did you -- that's where you changed the loadings using different loadings; correct?

A Yes. I used different inputs. I used different non-point source loadings, different wastewater treatment plant loadings. We reversed 05:04PM the order of the loadings, time order of the loadings, and we also specified the S and P stock index values as P to river.

Q Did you do anything else other than that test, sir? 05:05PM

A I can only recall the tasks that are in supporting statement 3A. I think I mentioned them all, but I'm not sure.

Q Did you actually do any sensitivity analysis that indicated that the routing model employed by 05:05PM Dr. Engel did not accurately represent the routing and delivery of phosphorus to rivers and streams in the IRW?

A I have to make some assumptions to answer your question. First of all, Dr. Engel's routing model 05:06PM

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in my opinion doesn't actually route anything, and he stated in his deposition that it merely is a time distributor for loads. So I think the routing model -- the term routing -- I know it has to be called something. It doesn't actually route anything. 05:06PM

Q But what I'd like you to do is answer my question.

A I'm sorry.

Q And that is, did you do anything to determine whether or not the model that Dr. Engel used, the 05:06PM routing model that he used --

A Yes.

Q -- in fact did not represent a valid representation other than what you did about Question 3A? 05:06PM

A Okay.

Q For example, did you use like CE-QUAL in-stream model to see if it produced different results?

A No. My contention here in statement 1C is 05:07PM that the routing model is not a representation of the real system of streams and rivers. I don't need to apply an alternate model to form that opinion.

Q Okay. What -- what in your opinion would be an appropriate model that would show a, quote, real 05:07PM

IN THE UNITED STATES DISTRICT COURT FOR THE
NORTHERN DISTRICT OF OKLAHOMA

W. A. DREW EDMONDSON, in his capacity as ATTORNEY GENERAL OF THE STATE OF OKLAHOMA and OKLAHOMA SECRETARY OF THE ENVIRONMENT C. MILES TOLBERT, in his capacity as the TRUSTEE FOR NATURAL RESOURCES FOR THE STATE OF OKLAHOMA, Plaintiff,	)
vs.	) 4:05-CV-00329-TCK-SAJ
TYSON FOODS, INC., et al, Defendants.	)

- -

VOLUME II OF THE VIDEOTAPED DEPOSITION OF VICTOR BIERMAN, PhD, produced as a witness on behalf of the Plaintiff in the above styled and numbered cause, taken on the 15th day of April, 2009, in the City of Tulsa, County of Tulsa, State of Oklahoma, before me, Lisa A. Steinmeyer, a Certified Shorthand Reporter, duly certified under and by virtue of the laws of the State of Oklahoma.

the data in this table indicate that poultry litter come -- poultry litter was one of two sources applied, and it gives dates, and it gives an area of the field, and it indicates that DRP and total P were monitored at the edge, and it provides a number 08:38AM for mean annual loss in kilograms per hectare. These data are referenced. The source of these data is a reference Vervoort, et al, 1998. I have not reviewed Vervoort, et al, 1998. So all I know is what I read in this table, in this paper. 08:39AM

Q There are several citations here --

A Uh-huh.

Q -- where it discusses poultry manure or litter being applied to grass fields; correct?

A Yes, that's correct. 08:39AM

Q How many; how many reports are referenced here where there's poultry manure litter applied to grass fields?

A Poultry manure, one, two, three, four -- excuse me. One is corn. Grazed fescue, one, two, 08:39AM three, four, five. Excuse me. Last one doesn't have poultry litter. If I've done this correctly, I think there are four.

Q Okay, and for all four of those studies, does it show that, based on natural rainfall, phosphorus 08:40AM

runs off from the edge of the field where manure or litter has been applied?

MR. BOND: Object to the form.

A This table contains no information about transport. What the table contains, it states that 08:40AM poultry manure has been applied and it states that various forms of phosphorus were monitored at edge of field. It does not establish that what was measured -- that the poultry litter was actually transported to edge of field, and these edge of 08:40AM field measurements actually represent phosphorus from poultry litter.

Q So you think all these studies were conducted -- using poultry manure so they wouldn't be able to establish whether there were phosphorus 08:41AM losses based on natural rainfall from edge of field where fields were applied by poultry litter?

MR. BOND: Object to the form.

A That's not what I said at all. What I said is you asked me to review this table, and without 08:41AM reviewing the primary references from which these data were derived, I have no information on the experimental design, the data that were acquired, and I cannot give an answer. There's no way I can fully evaluate what I'm seeing here. I can't agree, 08:41AM

of course, that poultry litter was applied, and I can't agree that phosphorus measurements were reported at edge of field, but that's all I know without further investigation of the primary sources, and I'm saying that I don't see anything in 08:41AM this table that establishes a transport connection.

Q Well, does the -- table title, Edge of Field Phosphorus Losses, is it not?

A Yes, it does, but that doesn't imply that all of the phosphorus or any of the phosphorus measured 08:42AM at the edges of these fields is from poultry litter. I would submit, sir, that rainfall -- if rainfall occurs and runoff from natural rainfall occurs and runoff occurs to edge of field, any soil contains phosphorus, and one would most likely measure 08:42AM phosphorus at edge of field whether poultry litter was applied or not.

Q And would those -- have you seen studies that compare edge of field losses from poultry-amended fields versus reference fields where there's been no 08:42AM poultry litter applied?

A I don't recall seeing such studies, and that's not what's in this table.

Q Isn't it true that those studies established that there's a hundred to a thousand time difference 08:43AM

between the concentration in loads at the edge of fields from reference fields when you compare those to poultry-applied fields?

MR. BOND: Object to the form.

A I'm not aware of such studies that show such 08:43AM results.

Q You used this paper and you cited it, correct, in your propositions in your report?

A Yes.

Q Did you detail study all of the other 08:43AM references for the points that were made in this paper, for points you relied on in your report?

A Which points are we referring to?

Q Well, I'm -- you seem to say, well, this paper includes Table 3 that has some information in it and 08:43AM I haven't read the published data that supports it.

A Uh-huh.

Q There was lots of published data cited in this report for many, many points. Did you study all of the published data that's cited in this Exhibit No. 08:43AM 12 before you used it for points made in your expert report?

A No.

Q Dr. Bierman, yesterday we were talking about one published paper where you told us that you had 08:44AM

published in a peer-reviewed journal information concerning a runoff model relating to field runoff; correct? That was with regard to the Everglades?
A Yes.
Q Okay. I want to hand you what we're going to mark as Exhibit 13, and first I'm going to ask you if you can identify that document for the Record, please, sir. 08:44AM
A This is a paper published in Ecological Modelling in 2001. It's entitled Exploring the Dynamics and Fate of Total Phosphorus in the Florida Everglades Using a Calibrated Mass Balance Model. The senior author is Ramesh Raghunathan. I am a co-author on the paper. 08:45AM
Q Okay. Is this the study that you were referencing yesterday with regard to runoff of fields? 08:45AM
A It's the study that I referenced in connection with what I called the Everglades water quality model. 08:45AM
Q Where you -- I'm sorry. Excuse me.
A I'm sorry. Which does contain representations of overland runoff and delivery of phosphorus by canals.
Q Okay. In the middle of the first page in the 08:45AM

chemical and biological resolution. We represented the loss of phosphorus within each model cell using a first order decay mechanism, which represented net deposition of phosphorus in each cell.
Q Okay. Now, how big are these cells? 08:47AM
A The cells are two by two because the hydraulic chassis for this model was the South Florida Water Management District two-by-two model and -- or excuse me. It's 3.2 by 3.2 kilometer cells.
Q So this statement here discusses how you treat phosphorus fate within each 3.2 by 3.2 kilometer cell? 08:48AM
A That's correct.
Q Okay, and so is how you treat phosphorus within those cells, that is, the fate of phosphorus, based on empirical observations of what you measured? 08:48AM
A It's been observed that phosphorus loads to the Everglades attenuate. Phosphorus is not conserved. Chloride is a conservative tracer. 08:49AM Phosphorus is not, and the data indicate that not all the phosphorus that's loaded into the Everglades actually is delivered via overland flow or to locations far away from the sources. It is lost in travel. 08:49AM

abstract, sir, there's a statement that begins simulated water column phosphorus dynamics; do you see that statement; sir?
A Yes.
Q Would you read that for the Record, please? 08:45AM
A Simulated water column phosphorus dynamics within each cell and canal is further controlled by a simple apparent net settling rate coefficient that integrates the effects of chemical, biological and physical processes and leads to a net deposition of 08:46AM phosphorus in the sediments.
Q Okay. Would you please explain what that statement means?
A This is a mass balance model that balances water and mass about each volumetric cell. The 08:46AM model tracks inputs of water and inputs of phosphorus to each cell. It tracks the outputs of water and the outputs of phosphorus from each cell. Inside the cell, phosphorus is not conserved. There are -- in process-based models, such as this, there 08:47AM can be sources or sinks of a chemical, in this case phosphorus, within a control volume. In this case the -- there is a net loss of phosphorus within each cell of the Everglades. That net loss can be represented at different levels of physical, 08:47AM

Q And that's what you mean by not conserved; some of the phosphorus is lost?
A Correct. Phosphorus is an element. Of course, it's conserved, but in the control volumes, that is, these volumes of water, it's not conserved. 08:49AM
Q Okay, and so what I'm trying to understand, sir, is how did you determine the phosphorus loss within the cells; did you do it by taking observations as to the amount of, for better term, loss of phosphorus within a cell? 08:49AM
A It's been ten years since we did the work. Let me take a look at the pages here.
Q Please do so.
A We actually calibrated the total phosphorus concentrations computed by the model to observed 08:50AM data as a function of space in the Everglades.
Q Okay. So it's kind of an empirical model of those cells?
A It was a process-based model, but the process was simple. It was a first order loss. It was not 08:50AM completely empirical because there was a mechanistic process.
Q But you made your determination as to the loss based on empirical observations; correct?
A That's correct. 08:50AM

Q And because you did it in that respect, you did not calibrate each process concerning phosphorus within each cell; is that correct?
A We didn't have data within each cell.
Q So the answer is you did not? 08:51AM
A Please repeat the -- I'm not sure that's quite accurate. Please repeat the question.
Q Okay. Let me try to ask the question again. My understanding is, studying this paper is that you did not -- within these cells concerning the loss of 08:51AM
phosphorus that you just described, you did not calibrate each separate process that you know that exists within the cell for phosphorus loss?
A That's not exactly correct. We didn't have data in each cell. Well, if you know the loads -- 08:51AM
if you know the hydraulics and you know the loads in and you know that phosphorus is conserved, that is, you don't gain or lose, and it's lost by net deposition from the cell, the calibration data allow you to back calculate what the net settling velocity 08:52AM
has to be to match the data, and in matching the data, you balance mass because this is a mass balance model.
Q Did you calibrate for sediment loss in this model? 08:52AM

A By calibration of the net -- of the net settling rate, that was calibration for loss from the water column to the sediment.
Q Were there other processes that talk about loss of phosphorus that describe loss of phosphorus 08:52AM
in this -- these cells that were not calibrated?
A Well, I don't believe so, but it's been eight years. This paper was published eight years ago. I would need to read this paper again and refresh my memory, but I believe the answer to your question is 08:53AM
in the jargon of environmental modeling, there was only one phosphorus process represented -- excuse me, that's not correct. There were -- the processes in this model were external mass loading. I'm referring to a given volume, a given cell. Each 08:53AM
cell sees the following processes. It sees a mass loading of phosphorus. It sees an inflow of phosphorus; it sees an outflow of phosphorus, and within the cell, it can see a loss of phosphorus which represents in this model net settling of 08:53AM
phosphorus from the water column to the sediment. So we have input processes; we have output processes, and we have one internal process, which is the first order of loss rate.
Q Okay. Are there any other processes other 08:54AM

than settling that affect phosphorus losses in these cells?
A Not in this model.
Q No, but are there in reality, sir?
A Any processes that affect -- actually, no, 08:54AM
there are not because if you load phosphorus into one of these volumes, it can either be created or destroyed, which doesn't happen because phosphorus is an element. It can go up and phosphorus doesn't volatilize. It can flow out, which we've 08:54AM
represented, or it can settle, which we have represented. So there's nothing that happens -- what I'm saying is that we've completely closed the mass balance loop.
Q What about contribution from the sediment -- 08:55AM
phosphorus contribution to the sediments; did you account for that in your model?
A Yes, because the settling velocity in this model is a net settling velocity, and that accounts for the net flux. The net of the gross settling and 08:55AM
the gross resuspension equals the net flux, and the net flux in this case was downward, and we've represented it with a net settling velocity.
Q Did you account for other inputs into the phosphorus, of the phosphorus in each cell, for 08:55AM

example, wildlife inputs?
A Wildlife inputs?
Q Yes. Wildlife inputs from wildlife waste, manure.
A Manure wasn't applied to these cells. I'm not 08:56AM
sure what the point of the question is.
Q Shore birds pooping in the water, fish.
A The fish that are there would have been accounted for in the initial conditions, and if the fish transfer phosphorus -- I'm not sure -- I'm not 08:56AM
sure what the point is. In answer to your question, we did not -- we did not -- we accounted for phosphorus loads from -- in the Florida Everglades there are two principal sources of phosphorus loads. There is -- as you probably know, the Everglades 08:57AM
river of grass, water flows from north to south through south Florida. The principal source of phosphorus to the Everglades is from the Everglades agricultural area, which is just north of the Everglades, and through overland flow and through 08:57AM
distribution in the canal system, this phosphorus migrates into the Everglades. The other primary source for this system is atmospheric deposition. We accounted for atmospheric deposition and for overland and canal flow from the Everglades 08:57AM

agricultural area.
Q Did you account for any urban contributions?
A No. There weren't any urban contributions to the Everglades.
Q There's no urban contribution of phosphorus to the Everglades? 08:58AM
A No. I take that back. That's probably not correct. I can't state for certain it's correct. If you give me a moment, we're getting down to a level of detail where I really need to read this 08:58AM paper that was published eight years ago to refresh my memory on exactly what we did. I've answered -- all the questions I answered are from my recollection of what's in the paper. If you want more details, I simply need time to reread it to 08:58AM make sure I'm giving you the correct answers.
Q Why don't we just go off the Record and let him read the paper?
MR. BOND: I think we ought to stay on the Record while he reads the paper. 08:58AM
MR. PAGE: It's his paper.
MR. BOND: He's a co-author of the paper that's ten years old. People don't remember everything that they've written from ten years ago.
MR. PAGE: But -- but he's told us 08:59AM

yesterday that this is the paper that represents experience he has in field runoff modeling, and I'm asking questions about field runoff contributions of phosphorus. I think that's appropriate. Are you telling me you object if we go off the Record to let 08:59AM him do it?
MR. BOND: Yeah.
MR. PAGE: Okay. Keep the camera on and watch him read it.
Q Go ahead it and read it. Take as much time as you need: 08:59AM
MR. BOND: David, could we bring somebody in by phone right now? Vicki is trying to dial in.
MR. PAGE: Please go right ahead. The more the merrier. 09:08AM
Q You ready? All right.
MR. PAGE: How much time elapsed?
COURT REPORTER: It was 13 minutes.
MR. PAGE: I'd just like the Record to reflect we've spent 13 minutes allowing -- 09:12AM
MS. BRONSON: Vicki Bronson for Simmons Foods.
MR. PAGE: -- allowing Dr. Bierman to review the paper, Exhibit 13.
Q Now, Dr. Bierman, my question was: Did you 09:12AM

consider urban contributions in this model?
A The answer is yes.
Q What are you basing that on, sir?
A They were included implicitly. This model -- this model has -- let's go to Page 251. 09:13AM
Q Okay.
A At the bottom of Page 251, left-hand side, the very last paragraph begins with the external loads of nutrients to the EWQM grid were input as surface water, groundwater and atmospheric loads. The 09:13AM surface water loads were those principally entering the flow control structures located along the periphery of the model domain. The surface water -- I'm jumping a few sentences down. Surface water loads were calculated as the product of a monthly 09:13AM average flow and a monthly median concentration.
Those structures -- the water that flows through those structures is from a number of different sources. Some of it is agricultural area and some of it is urban area. So what was done was 09:13AM we used data for flow and concentration at the model boundaries to compute the load that was entering the model spatial domain.
Q Okay. How did you determine -- so you're determining concentrations, loads, volume of 09:14AM

phosphorus at canal entry points to the Everglades; correct?
A That's correct. Those are the entry points.
Q Okay. How did you determine the concentrations that ran off the fields that contributed to those canals? 09:14AM
A The Everglades is not a natural system. It's been extensively replumbed by the Corps of Engineers as part of the central and south Florida project earlier in the 20th century to control floods. 09:15AM Water leaves the major portion -- I'm reading at the bottom of Page 248. The major portion of phosphorus loads, this is to Water Control Area 2A, for example. Enters through the S10 structures. S10-A, S10-C, S10-D. The South Florida Water Management 09:16AM model, which is the hydraulic chassis upon which this model was built, tracks the waters coming into the Everglades through all the control structures, through overland flow and through groundwater. We use the hydraulics from that model to specify all of 09:16AM the inflows at our boundary, and we use concentration data at those boundaries to determine phosphorus load from the boundaries, from the canals and from the atmosphere.
Q How did you determine field runoff from any 09:16AM

source? I still don't think you've answered my question.
A The South Florida Water Management model represents the -- both overland flow entering the Everglades, as well as flow entering the canals. It also represents groundwater. Those are three -- there are four sources by which water can enter the Everglades. I just listed three. The fourth is --
Q But I'm asking you about overland flow.
A And I told you -- my answer is that we used the surface flows computed by the South Florida Water Management model and data, phosphorus data for boundary concentrations, multiplied the two together, and that's how we determined the phosphorus inputs due to overland flow and we did the same thing for the canals and the same thing for the groundwaters.
Q Are the processes that talk about overland flow in the South Florida Water Management model described in this paper?
A They're not described in this paper. That paper -- that work is included by reference in several locations because we relied upon that model and its outputs.
Q Did you develop that model, the South Florida

Water Management model?
A No, I did not develop that model.
Q Who did?
A The South Florida Water Management District staff developed it. It's a very sophisticated tool. It's very data rich.
Q You've answered my --
A Many staff and many years have been spent developing and calibrating that model to south Florida.
Q But the overland portion of this work in this paper was performed by someone else, not you or your office; is that correct?
MR. BOND: Object to the form.
A The overland hydraulics at the boundaries to specify loads were developed by others. The phosphorus mass balance model that we developed here represents phosphorus movement in the three-by-three cells, the overland areas and the canals within the Everglades. That work was done by my office, and that's what this model represents. We need -- I think we're stuck here on is the difference between how did we put data into this model and what the model itself actually represents inside the Everglades. This model is of the Everglades.

Q Let me tell you what I'm struck on and maybe you can help me clear it up. Yesterday I asked you what experience you had, in particular any peer-reviewed publications where you actually did work on overland field type runoff contributions of phosphorus, and I believe you referenced this paper as a publication.
A That's correct.
Q And what I discovered, I believe through this examination this morning, is that the work on the runoff itself was not done by you or your office; it was done by someone else; is that not correct?
A Not completely. The work -- the hydrologic model was done by South Florida Water Management District. We used results from that model. We then inside our model spatial domain routed water and routed phosphorus inside these spatial cells across overland areas and through canals.
Q Okay, and so the folks that actually determined the quantity of field runoff was the South Florida Water Management folks; is that correct?
A Yes, that's correct.
Q And they were the ones that also identified the particular sources of field runoff for

phosphorus also; correct?
A Into this model domain, that's correct.
Q Okay, and they also -- well, I think that answers my question. And do you know, sir, from your work on this project what the urban contribution was, that is, the percentage?
A No, I don't.
Q The agricultural percentage?
A No. Those weren't objectives of our work, and I don't know the answers.
Q Okay. Was there a septic tank contribution considered as part of the contribution?
A We didn't consider it explicitly. It may have been included implicitly in the boundary conditions, but I don't know that for sure.
Q What about wildlife?
A Again, that may have been considered implicitly in the boundary conditions. We did not consider it explicitly in the study.
Q Illegal dumping?
A I didn't consider illegal dumping.
Q Recreational use, contributions of phosphorus from recreational use?
A Included implicitly in the model inputs, as would illegal dumping actually.

A Yes.
Q -- of the report?
A Yes, I'm there.
Q What -- then also keep your hand on that page, if you would, and turn to Page 69 also. 10:09AM
A Yes.
Q Okay. On Page 55 does it show at Sites 33 and 35 that there's a decreasing trend in sediments over the 1993 to 2004 time period?
A At what sites, please? 10:10AM
Q 33 and 35. Is there a decreasing trend shown by the USGS for the time period 1993 to 2004?
A Just so I'm reading this correctly, can I point to what I think Sites 33 and 35 are?
Q Well, you can circle. You can circle them on the paper, if you would do that, sir. 10:11AM
A There seem to be two sites together.
Q Yes.
A Okay. Thank you.
Q Now, would you identify -- please go ahead. 10:11AM
A Yes. In answer to your question, this -- this graph shows that a decrease in trends in percent per year were determined for suspended solid loads at those sites that you mentioned, 33 and 35, between 1993 and 2004. 10:11AM

Q Now, will you turn with me, sir, to Table 69 and identify for the Record the locations of 33 and 35.
A 33 is the Illinois River near Tahlequah and 35 is Baron Fork at Eldon. 10:11AM
Q Okay. Those two sites, Illinois River at Tahlequah and Baron Fork at Eldon, represent how much of the water load in the IRW going into Lake Tenkiller?
MR. BOND: Object to the form. 10:12AM
A I don't know exactly, but let me answer it this way: The three primary delivery pathways for water from the IRW to Lake Tenkiller are through the Illinois at Tahlequah, Baron Fork near Eldon and Caney Creek at Barber. Illinois is the largest. 10:12AM Baron Fork is the second largest. So those two together comprise most of the flow from the IRW to Tahlequah. I can't give you a number.
Q Thank you, sir. Dr. Bierman, I want to turn to your report, sir, on Page 8. 10:13AM
A Yes.
Q I'm looking at the first full paragraph on Page 8. Would you just take a second to summarize for us the criticism that you're expressing on this page at that location? 10:13AM

A I'll need to refer to the figures.
Q That's fine, sir. Just identify them for the Record, if you would.
A Sure. The criticism in this paragraph pertains to misrepresentation of the land use types 10:14AM in the input files for Dr. Elm -- Dr. Engel -- I'm sorry, Dr. Engel -- Dr. Engel's GLEAMS model, and Figures 2 -- the Figures 2, 3, 4 and 5 are intended to be illustrative examples of some of these errors. Figure 2 is provided as a key to interpretation of 10:15AM the imagery that is presented in Figures 3, 4 and 5.
Q Well, let me ask you what -- so you're saying Dr. Eng -- the land use data that Dr. Engel used for the GLEAMS model had some errors in it; is that what you're suggesting? 10:15AM
A Let me reread my -- Dr. Engel had GIS data files that he used to construct the input files to his GLEAMS model, and I'm stating that those files contained errors because land that was forestland from the NLCD data was classified as pasture by Dr. 10:15AM Engel, and some lands that were urban and roads were also classified as pasture in Dr. Engel's files.
Q Okay, and that GIS data, was it not the 2001 National Land Cover Dataset that Dr. Engel used?
A Dr. Engel used the 2001 NLCD data. 10:16AM

Q So your criticism is that the 2001 NLCD data had some errors in it?
A No, no. The NLCD data require classification as to which areas are forest, which areas are urban and which areas are roads and which areas are 10:17AM pasture. Those are judgments that are made based on the primary data, and what I've presented in Figures 3, 4 and 5 are examples using the NLC data. Figure 3 shows examples of forested land as they -- in the NLC data but that were classified as pasture by Dr. 10:17AM Engel in his GLEAMS model. Figure 4 shows examples of urban land from the imagery that Dr. Engel classified as pasture in his model input files, and Figure 5 shows examples of roads that were classified as pastureland in Dr. Engel's model. 10:17AM
Q Okay. Does the NLCD or the National Land Cover Database identify the land uses for the user?
A I don't recall at what level of detail the NLC data -- the NLCD data classifies land use.
Q Okay. 10:18AM
A I don't recall the details of how they determined the different land use types.
Q Did Dr. Engel use the determinations by the NLCD for land use?
A I don't know. I would have to investigate my 10:18AM

files to determine that.
Q Is the National Land Cover Database used by field runoff modelers to determine land uses for their models?
A That's a common database that's used. 10:18AM
Q You showed some examples on Figures 2 through I think 5?
A Yes.
Q Did you determine how much of the million acres was in your view misclassified by the way Dr. Engel used the NLCD database? 10:19AM
A We did not determine the percentages or the areas in all cases for what we judged to be misuses or misrepresentations of land areas. We did it for selected cases as -- one, two, three -- as I've 10:19AM indicated in the third full paragraph, but we didn't do it for every case. In other words, we didn't correct it or we didn't do it over. We simply noticed large numbers of what we determined to be misclassification, and we presented the information 10:20AM in these figures as illustrative examples we, but we didn't quantitate it.
Q What do you mean by large numbers; how many?
A It depends how size -- it depends how large or small you make your GIS field as you're navigating 10:20AM

through the images. It also depends on how you mean by misrepresent. I would say dozens, dozens, tens.
Q Do you have experience in interpreting aerial photo such as presented in the NLCD dataset?
A I personally do not. 10:20AM
Q I suppose since you didn't determine the total quantity of alleged misclassifications, you don't have an opinion on whether or not this issue that you've raised has an effect on Dr. Engel's results, do you? 10:21AM
MR. BOND: Object to the form.
A It has an effect on the results because if the -- if you don't get the land used correct, you can't get the loads correct because different land uses have different runoff characteristics, but I 10:21AM did not quantitate that difference, the discrepancy.
Q Well, if you -- if some forest was shown as pasture, was some pasture also shown as forest so they would even out?
A I don't recall that we saw pasture classified 10:21AM as forest.
Q Did you look at all of the land use or just some locations that you selected?
A We didn't look at all of them, but we certainly didn't select them. We were doing a 10:22AM

consistency check between the NLCD primary data and Dr. Engel's files and we noticed discrepancies. So we investigated deeper and we noticed a large number of discrepancies, some of which I've reported out quantitatively in the middle paragraph of this page 10:22AM and others of which I simply showed illustrative examples in Figures 2 through 5.
Q Well, if you don't have experience in interpreting aerial photos for land cover data, how do you know that the classifications were incorrect? 10:22AM
A Because I have highly trained and competent GIS staff who have that experience in looking at NLCD images and making determinations about land use areas.
Q So you didn't do this analysis yourself? 10:22AM
A I had staff do the analysis, that's correct.
Q Can we look at Figure 3, sir?
A Yes.
Q Okay. Figure 3 is an example of your concerns about inconsistencies; is that correct? 10:23AM
A Yes.
Q Okay. Is NLCD data -- let me ask this question first: Is it remote sensing data?
A You mean satellite as opposed to airplane?
Q Yes. 10:24AM

A I don't know.
Q Is GIS the same as remote sensing data?
A Remote sensing data can be placed into -- GIS is a tool. GIS is not data.
Q Let's look at Figure No. 3. 10:24AM
A Yes.
Q Could you explain what the top image is intended to show? I take it you did not prepare this?
A That's correct. 10:24AM
Q Okay. What do you understand the top image to show?
A The rectangle in the top image corresponds to what's indicated, the rectangle in dark green indicated as No. 1 in the Illinois River watershed 10:25AM map just to the left.
Q Okay.
A The -- so the rectangle that we're talking about is 1, and the bottom panel corresponds to the dark green smaller rectangle which is labeled No. 2 10:25AM in the green Illinois River watershed map in the upper left corner. So these are just blow-ups of 1 and 2.
Q Okay, and what are the problems with the Blow-Up No. 1 that you claim? 10:25AM

A The rectangle corresponds to area that Dr. Engel classified as pasture. The ellipsis inside the rectangle correspond to forest areas, forestlands, and the point is that the entire rectangle does not completely represent only pasture. There's forestland in there as well, which would have different runoff characteristics.

Q Did you determine what the effect of this alleged misclassification on Figure 3 would have on Dr. Engel's model? 10:26AM

A Not quantitatively, no.

Q In the bottom figure what are you intending to represent by the bottom figure of Figure 3?

A The rectangle labeled No. 2 represents a portion of land area that Dr. Engel classified as pasture. In the legend Engel classified forest as pasture, points to a portion of land within that rectangle is that is not pasture but it's actually forest.

Q Okay. Did you quantify the effect that this alleged misclassification would have on the model? 10:27AM

A No, I did not.

Q Let's turn to Page 4 or Figure 4. Excuse me, sir.

A Sure. 10:27AM

Q And then there's a couple more figures on the same topic, I guess, on this page?

A Yes, there are.

Q Okay. Let's look at No. 1 on the top part of Figure 4. What is that purported to show? 10:27AM

A Well, again, we see -- the Illinois River watershed map in the upper right has three rectangles labeled 1, 2 and 3, and the panels in the upper left and on the bottom are blow-ups of those locations. This is an example of urban land use that was classified as pasture by Dr. Engel in his GLEAMS model. 10:27AM

Let's look at the rectangle in the upper left-hand corner. The rectangle encompasses land that Dr. Engel classified as pasture, but the legend and the callout indicates that there's residential urban land under development in that box, which is not pastureland. 10:28AM

Q Who made that interpretation that that was residential urban land under development that was classified as pasture? 10:28AM

A My GIS staff.

Q Do you know what factors they used to make that determination?

A It was explained to me at the time during preparation of this. I don't remember the details. 10:28AM

Q Let's turn to page -- Figure 5.

A Yes.

Q Another figure -- what is shown on No. 1, Box No. 1? 10:29AM

A Again, the rectangle, the blue rectangle inside Figure 1 represents an area that Dr. Engel classified as pasture, and roads are visible. Specifically Highway 59 is visible as running through the box and that was also captured in an area that was represented as pasture. 10:29AM

Q So that small road there was part of Dr. Engel's classification using NLCDS pastureland?

A I won't characterize -- well, it's a matter of opinion whether it's small. The point is that the road is not pasture. 10:29AM

Q What percentage of that square would be represented by the cover of a road?

A I don't know. I didn't quantitate it.

Q Small percentage; less than half? 10:30AM

A I don't want to speculate.

Q Let's -- Image No. 2, what's the issue with Image No. 2 on this page?

A It's the same issue. The land inside the box was represented as pasture. Highway 512 is 10:30AM

represented as pasture.

Q Then there's a little elliptical. What is the point with that elliptical in Box No. 2 on Figure 5?

A Inconsistent classification, not grouped with pastureland. Sitting here right now, I don't know what that means. I've forgotten. 10:31AM

Q On Page 8 of your report, sir --

A Yes.

Q -- you make a statement that says, again, these misrepresentations. Is it your position, sir, that Dr. Engel misrepresented the land use, intentionally misrepresented the land uses? 10:31AM

A My opinion here implies no claim of motive. I'm simply -- the word misrepresentation, as I've written it here on Page 8, simply means that there is an inconsistency between the NLCD data and how Dr. Engel represented those land uses in his model inputs. There is no intent on my part to attribute motive. 10:31AM

Q Okay. Would you read the full paragraph there? It begins again for the Record. 10:32AM

A Which paragraph, sir?

Q Where I was looking at misrepresentations. Again these --

A Again, these misrepresentations are important 10:32AM

because different land uses will contribute different phosphorus loads per acre, and Dr. Engel's GLEAMS model cannot predict the correct phosphorus load or the correct phosphorus sources with the land uses represented incorrectly. 10:32AM

Q What tests did you perform to validate that statement?

A I didn't need to perform a test because I know and, in fact, in Dr. Engel's own work, the scientific literature, a huge body of information 10:32AM indicates that the phosphorus runoff per unit area from different land uses is different. There is no such thing as a one size fits all runoff coefficient. One cannot get the total phosphorus loads correct unless we get the land use correct. 10:33AM

Q And how do you know that these small errors that you've identified, which you haven't been able to quantify, had any effect on Dr. Engel's results --

MR. BOND: Object to the form. 10:33AM

Q -- if you didn't do some test?

MR. BOND: Object to the form.

A This was a mass balance model. If the areas are incorrect, the total phosphorus loads will be incorrect. I don't need to conduct an investigation 10:33AM

to assert that opinion.

Q But if there was an equal amount of phosphorus -- excuse me, pasture classified as forest and forest classified by pasture, wouldn't they balance out? 10:33AM

MR. BOND: Object to the form.

A Probably not because the many other factors, including the runoff coefficients, would also have to balance out for that to occur, and that hasn't been established that that's the case. 10:34AM

Q Next sentence below that, there are also substantial inconsistencies. How do you define substantial, sir?

A As I've indicated, the GLEAMS hydrology input files for Baron Fork contain 30,531 fewer acres of 10:34AM forest, 2,550 fewer acres of pasture and 215 fewer areas of urban land when compared to the areas in this GIS files. In my opinion inconsistencies on the orders of tens of thousands of acres are substantial. 10:35AM

Q Were those acres included in one of the other subbasins of the IRW?

A I'm sorry, sir, I don't understand the question.

Q You said there's 30,531 fewer acres of forest 10:35AM

in the Baron Fork subwatershed than what your people identified as forest; correct? I'm simply asking whether that forest was attributed to either the Caney basin or the Illinois River basin.

A I see. I don't believe they were because we 10:35AM conducted this analysis at the level of each of the three subwatersheds, and what we determined, as I stated, is that there were 33,296 fewer acres represented in the GLEAMS model for the Baron Fork subwatershed than the total number of acres in the 10:36AM GIS data files from which these drainage area and the hydrology input files were derived. So this is an inconsistency between the hydrology model and the phosphorus model.

Q Okay. Were those acres attributed to a different watershed? 10:36AM

A Not to my knowledge.

MR. BOND: Object to the form.

Q Did you do an evaluation to determine that?

MR. BOND: Object to the form. 10:36AM

A My GIS staff person evaluated each of the watersheds separately.

Q And what did they determine with regard to what I just asked?

A They did not determine that those acres were 10:36AM

carried over into another watershed.

Q Did they make that check?

A I believe they did, but I can't recall.

Q Isn't it true, sir, that field surface runoff modelers allow for a 5 percent error rate using NLCD 10:37AM type data on land use classification?

A I'm not aware that there's a specific percentage in the watershed modeling community that's accepted and generally supported. I don't doubt that some individual investigators think that 10:37AM 5 percent is a number they would use for that purpose.

Q Are you aware of any studies where they've determined whether or not a 5 percent error rate in the NLCD data is inconsequential to watershed 10:37AM modeling?

A No, I'm not.

Q You do agree with me, sir, that use of NLCD data is typically employed by watershed modelers for a runoff model; is that correct? 10:38AM

A That's my understanding, yes.

MR. PAGE: Why don't we take our break now.

VIDEOGRAPHER: We are off the Record at 10:39 a.m.

(Following a short recess at 10:39

a.m., proceedings continued on the Record at 10:50 a.m.)

VIDEOGRAPHER: We're back on the Record at 10:50 a.m.

Q During the break, Dr. Bierman, I've handed you Exhibit 15. Can you identify it for the Record, sir? 10:50AM

A Yes. It's a paper published in the transactions of the ASABE in 2008. The title is Tillage Practices Using -- excuse me -- Tillage Practices Usage in Early Warning Prediction of Atrazine Pollution, principal author J. E. Quansah and co-authored by Dr. Engel. 10:50AM

Q And Dr. Chaubey?

A And Dr. Chaubey. 10:50AM

Q Do you know Dr. Chaubey, sir?

A No, I don't.

Q Did this -- are you familiar with this paper?

A No, I'm not.

Q Did this study employ the SWAT model? 10:51AM

A Well, it says it does in the abstract.

Q Okay. Would you please look at Page 1313, sir? On the left-hand column, the lower part of the left-hand column says SWAT setup. Do you see that, sir? 10:51AM

A Yes.

Q The last sentence that carries over to the top of the next column begins to. Would you read that sentence, sir?

A To control the number of HRUs, the multiple HRUs land use/soil -- soils option with a 5 percent/5 percent threshold respectively was used in computing the HRU distribution. 10:51AM

Q Does that mean for this SWAT model, sir, that the -- for HRUs, they used the land information, land use information that was representative of 95 percent of the HRU? 10:51AM

A I'm not sure what it means because all I've done is read that sentence. I notice the above material talks about the NLCD land use data. 10:52AM

Q Do you know -- I'm sorry. Go ahead, sir.

A I'm sorry. Unless I read -- again, sir, I -- just having read what I did out of context, I can't answer the question in detail.

Q Okay. Do you know whether or not it's acceptable practice in the field runoff modeling community to use NLCD data whereby your HRU land use is represented by 95 percent of the land use within the HRU? 10:52AM

A I don't know if that's a generally accepted 10:52AM

practice in the watershed modeling community. It appears to say, if I understand what I just read correctly, that that's what was done in this paper.

Q Do you know that the watershed community sometimes uses land use distributions on HRUs as -- as low as where 75 percent of land use is representative and used for the HRU characterization? 10:53AM

A I don't know that for a fact but, again, these decisions depend on the objectives of the model, the purpose of the model, how the information will be used and this -- I don't see any mention in this paper of litigation. Whereas, Dr. Engel's GLEAMS model that he put forth in his expert report is being used as a basis to support claims in this case. 10:53AM

Q And --

A As Dr. Engel himself has stated in his -- I think he entitled it his graded QA/QC approach, that the standards should be higher for modeling studies whose results are to be used in support of litigation. 10:54AM

Q Do you know how Dr. Engel's modeling study compares to other field studies, whether the QA/QC for the modeling study in this case was more rigorous than other field scale modeling studies that are published? 10:54AM

MR. BOND: Object to the form.

A That's a broad question, sir. I don't fully understand it. 10:54AM

Q Isn't it true, sir, that you have never personally evaluated land use for field runoff model inputs?

A Yes.

Q Isn't it also true, sir, that the determination as to classification of land use for field runoff is typically within the judgment of the modeler who's employing the model? 10:55AM

MR. BOND: Object to the form.

A Those decisions typically are made by the modeler based on judgment, that's correct, and I simply pointed out in the opinion that we were discussing that inconsistencies between the primary data and the land uses that Dr. Engel used as inputs to his model. 10:55AM

Q Let's turn to Page 9 of your report, sir.

A Yes.

Q Could you read the supporting statement 2C for the Record?

A Yes. Dr. Engel ignored most of the available 10:56AM

data in the IRW when he provided the inputs for initial soil phosphorus concentrations in his GLEAMS model.

Q Have you ever, sir, reviewed soil test phosphorus data for use in a runoff model? 10:56AM

A I've reviewed the materials produced in this case.

Q Prior to the review of this case, have you ever done that analysis in a modeling framework?

A No. 10:56AM

Q You cite on this page Knisel, Knisel and Davis paper I think from the GLEAMS manual.

A It's the GLEAMS manual.

Q Would you read the last sentence of the italicized portion there for the Record, sir? 10:57AM

A Did you say the very last sentence?

Q Yes, model users.

A Model users are strongly, underscore, urged to make every effort to obtain the best estimate possible for these parameters, which may involve 10:57AM soil sampling and analysis.

Q Okay. What did the authors of that paper mean by the best estimate possible --

MR. BOND: Object to form.

Q -- if you know? 10:57AM

A Well, I think I do know because there's more to that paragraph. The sentence above it points out that initial values of different conceptualized pools are very site specific and are generally very management dependent. This is especially true for 10:57AM systems with animal waste production -- excuse me, application, those with intensive management, such as high levels of fertility and production, and conservation tillage systems with heavy residues left on the soil surface. And the intent of this 10:58AM paragraph is to advise GLEAMS model users to use site-specific data to obtain the best available information for those parameters.

Q Does it actually say you have to use site-specific data to get the best estimate possible? 10:58AM

A Well, it says initial values are very site specific, and then it says model users are strongly, underscore, urged to make every effort to obtain the best estimate possible, which may involve soil 10:58AM sampling and analysis. My sense of this paragraph says, yes, site-specific data should be used, especially if these data are available and, in fact, this statement even suggests that if those data are not available, additional soil sampling and analysis 10:59AM

should be conducted.

Q Does it say should be or say may?

A May, excuse me, it may involve.

Q So you've interpreted it differently than what the actual word stated, have you not; you've taken 10:59AM **your own interpretation of these records?**

A Sir, all I did was make a mistake and used the word should instead of may. Everything I said prior to that point still stands on its own.

Q Have you ever done any GLEAMS modeling to 10:59AM **determine whether or how this type of information that's discussed here from the Knisel paper is important to the analysis?**

MR. BOND: Object to the form.

A I personally have exercised Dr. Elm's -- 10:59AM excuse me, Dr. Engel. I apologize again. I personally have exercised Dr. Engel's GLEAMS model of the IRW for the actual condition periods -- the actual condition period 1997 through 2006 for each of the three subwatersheds. I have not personally 11:00AM done simulations where I have done a formal sensitivity analysis on the STP concentrations in the model.

Q How would you relate your experience on fields runoff modeling compared to the experience of Dr. 11:00AM

Engel?

A I have as much experience running his model, his GLEAMS model of the IRW as he claimed to have had in his deposition. I've run it about a half a dozen times. 11:01AM

Q I move to strike as not responsive. Let me ask the question again, Dr. Bierman. How much experience do you have with runoff modeling, land runoff modeling compared to Dr. Engel's experience; would you say they're comparable? 11:01AM

A I won't quantitate it, but Dr. Engel has more experience doing that kind of modeling than I have.

Q Okay. Would you pull out Exhibit No. 5, sir? It's the paper by Keith Willett.

A Yes, I have it. 11:03AM

Q Would you -- would you identify again for the Record what this paper is?

A It's a paper published in the Journal of Environmental Planning & Management 2006. The title is The Opportunity Cost of Regulating Phosphorus 11:03AM From Broiler Production in the Illinois River Basin, Keith Willett, senior author.

Q Would you turn with me to Page 198?

A Yes. I'm there.

Q Would you look with me at the first full 11:04AM

the IRW have changed substantially over the last some decades. That's just common sense to me.

Q Oh, really? Well, are you aware, sir, that most of those default parameters relate to soil processes and not whether or not the land use has changed? 01:14PM

MR. BOND: Object to the form.

Q Your example was urbanization has changed, but do any of those default parameters relate to urbanization changes or aren't they in fact simply parameters that describe soil processes? 01:15PM

MR. BOND: Object to the form.

A There are many different parameters that describe soil processes and other processes as well. I have listed these parameters. 01:15PM

Q You've listed the default parameters in your report that you have concern with?

A I have concern with all 130 of the default parameters that Dr. Engel used because they were not supported and/or based on data that are not specific 01:15PM to the IRW and/or represent conditions pre- 1980.

Q Sitting here today, you can't identify one single parameter of those 130 that you have a concern with?

MR. BOND: Object to the form, asked and 01:15PM

answered.

A I believe I've adequately answered your question, Mr. Page.

Q Can we turn to Page 15 in your report, sir?

A Yes. I'm there. 01:17PM

Q Would you read supporting statement 2F, sir?

A Yes. In contravention to generally accepted practices in the scientific community, Dr. Engel did not compare the predictions for hydrology from his GLEAMS model to any observed data in the state of 01:17PM Arkansas or to most of the observed data in the state of Oklahoma.

Q Okay. Can you provide me a peer-reviewed article that supports that statement that you made in 2F? 01:17PM

MR. BOND: Object to the form.

Q Provide me a citation to a peer-reviewed article that supports the statement --

A I don't need a peer-reviewed scientific article to support that statement, sir. When one 01:17PM develops and applies a site-specific model, it is certainly not common practice to ignore 79 percent of the hydrology measurements if one has developed and calibrated and purported to validate a hydrologic model. 01:18PM

Q So you can't provide me with any references that indicate that the amount of climate data that Dr. Engel used in this case was inappropriate for his use in the IRW?

A That wasn't my statement, sir. 01:18PM

Q Okay. Can you provide me any information?

MR. BOND: Object to the form.

A Please state the question again.

Q Can you provide me a peer-reviewed article that suggests that the quantum of data that Dr. Engel used with regard to climate information was inappropriate for the IRW? 01:18PM

MR. BOND: Object to the form.

A If by climate, are we talking of hydrological data or climate data? In any case, I don't need a 01:18PM peer-reviewed publication to tell me that in the development and calibration of a watershed model, that a modeler should ignore most of the available precipitation data. I can't find the number at the moment, and 79 percent of the available hydrologic 01:19PM measurements with which to calibrate the model, especially given the high stakes, the serious consequences, the large claims and the rigor and QA/QC demanded by a litigation case such as this.

Q Did you do any sensitivity analysis to see whether the additional rainfall data would have been -- had an effect on the modeling results? 01:19PM

A No, I did not.

Q Given the high stakes involved in this case, why didn't you do that evaluation? 01:19PM

A Because it was Dr. Engel's model. It was incumbent upon him to use the available data. It was not incumbent on me to recalibrate his model, correct it, do it over or input all of the available data that he should have input in developing his 01:20PM model to support his claims in this case.

Q So you believe it's not incumbent upon you to support your claims of mistakes?

MR. BOND: Object to the form.

A I disagree that I'm mistaken in this matter, 01:20PM and my claim is simply -- and let me find the statement Dr. Engel ignored 73 percent of the available rainfall data.

Q Okay, but you've done no sensitivity analysis that would have an impact on his model; correct? 01:20PM

A I don't need sensitivity analyses to tell me that -- to support my claim that Dr. Engel could have and should have used the additional -- the rainfall data -- let me say it this way: Dr. Engel should not have ignored 73 percent of the available 01:21PM

rainfall data.
Q What's your basis for that?
A I don't need a --
Q If you don't have a sensitivity analysis, what's your basis for the fact that that was important to the amount of model output that Dr. Engel produced? 01:21PM
MR. BOND: Object to the form.
A On Page 9 of my expert report, the first paragraph, Shoemaker, et al, 2005, state ultimately input of time varying and spatially detailed meteorological information can support more accurate calibration and application of watershed models, particularly in the prediction of hydrology. Hydrology is particularly sensitive to variations in spatial distribution of precipitation and temperature. The use of these additional data -- when Dr. Engel ignored 73 percent of the available data, it wasn't just quantity of data that he ignored. He ignored data in different spatial locations that would have allowed him to more accurately represent variations in spatial distribution of precipitation and, again, sir -- 01:21PM 01:21PM
Q Would it have --
A Please let me finish my answer. It was his 01:22PM

model and it was his responsibility to use those data. It was not my responsibility to conduct sensitivity analyses of his model after the fact.
Q Was the model inaccurate on predicting loads to -- let me just ask: Was the model inaccurate? 01:22PM
A That's a broad question. I can't answer that question. Please be more specific.
Q Was -- how can you support your position that the spatial variations that may be represented by additional climate data would have influenced the determination of the relative contributions of phosphorus to Lake Tenkiller from the different sources within the IRW? 01:22PM
A I didn't claim it would. I'm simply pointing out that Dr. Engel ignored 73 percent of the rainfall data. I did not conduct sensitivity analyses to determine what the consequences of using all of the rainfall data would have been on the phosphorus loads computed by the model. Again, sir, it was not my model. 01:23PM 01:23PM
Q When you did your work for the Everglades, did you use all of the available climate rainfall data for that model?
A My recollection is that we used all of the available rainfall data from the South Florida Water 01:23PM

Management District. They provided those data to us.
Q Did you determine whether that was all of the available data or just a select portion?
MR. BOND: Object to the form. 01:24PM
A I can't recall, but knowing how the South Florida Water Management District operates, I'm sure it included all of the appropriate data.
Q All of the appropriate data but not necessarily all of the data that's available; is that what you're testifying to today, sir? 01:24PM
A By the appropriate data, I mean all of the precipitation data that would have been relevant and applicable to that model application and that spatial domain. 01:24PM
Q What evidence do you have that Dr. Engel did not use all relevant and appropriate data for the application to the model he's prepared for the IRW and the purposes for which that model was prepared?
A He ignored 73 percent of the data and did not explain why and did not explain in -- his expert report did not support his decision to ignore these data. Again, sir that was incumbent upon him. It's his model. 01:24PM
Q Did you ask counsel during Dr. Engel's 01:25PM

deposition to inquire as to Dr. Engel's selection of rainfall data and his basis?
A I can't recall.
Q What about the other hydrological data that's represented in 2F; did you ask counsel to inquire of Dr. Engel during his deposition why he did not use all of the available hydrologic data as you claim in statement -- 01:25PM
MR. BOND: Object to the form.
A I can't recall. 01:25PM
Q Does Dr. Engel do site-specific calibration for his modeling, that is, use site-specific information to calibrate his model?
MR. BOND: Object to the form.
A Which model? 01:25PM
Q The GLEAMS model with the routing application.
A Is it the GLEAMS model, the routing model or both? I want to understand the question.
Q Both together. Does he use site-specific information to calibrate the GLEAMS and routing model together? 01:26PM
A To calibrate and purportedly validate his GLEAMS and routing models, Dr. Engel used flow data and has computed phosphorus loads at three USGS stations, the last three stations just above the -- 01:26PM

Lake Tenkiller and those stations being Illinois River at Tahlequah, Baron Fork near Eldon and Caney Creek at Barber. Those data are site specific in that they were acquired in the IRW. He used those data to calibrate his GLEAMS and his routing models. 01:27PM There's another level of my answer to your question. His routing model computes phosphorus loads to Lake Tenkiller, and he used data representing phosphorus loads to Lake Tenkiller to calibrate and purportedly validate that model. His GLEAMS model computes 01:27PM loads at edge of field. He also used the phosphorus loads from those three stations to calibrate his GLEAMS model. However, those are not site-specific data in the sense that that's not what his GLEAMS model compute. His GLEAMS model computes phosphorus 01:27PM loads at edge of field. The loads at those three stations are up to 100 miles away from what GLEAMS itself is actually computing. So although he used those data to calibrate his GLEAMS model, he did not calibrate the GLEAMS model to site-specific data 01:28PM that represented what the model was actually computing.

Q What was the model actually computing; that is, the GLEAMS model, in conjunction with the routing model, what was it computing in your 01:28PM

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opinion?

A I think you just asked two questions. The GLEAMS model was computing --

Q No. I was asking you one question. I said, when you put the GLEAMS model together with the 01:28PM routing model, what was it computing?

A The GLEAMS model computes --

MR. BOND: Object to the form.

A -- non-point source phosphorus loads to edge of field in each of the 50 HRUs in Dr. Engel's 01:28PM GLEAMS model. Dr. Engel then adds to those edge of field loads wastewater treatment plant loads that are determined independently outside the model. When those loads are added together, it forms a quantity that Dr. Engel called P to river. P to 01:28PM river is the input to Dr. Engel's routing model. Dr. Engel -- the output from Dr. Engel's routing model is P to lake. For each of the three watersheds, he applied the coupled GLEAMS routing models to each of the three watersheds. It's the 01:29PM output of the routing model for total phosphorus loads that he actually compares to what he calls his observed loads at those three stations that I just mentioned in my previous testimony.

Q Let's look at statement 2G on Page 16. 01:29PM

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A Yes.

Q Would you read that for the Record, sir?

A In contravention to generally-accepted practices in the scientific community, Dr. Engel did not compare the predictions for phosphorus loads to 01:30PM edge of field from his GLEAMS model to any observed data in the states of Arkansas or Oklahoma.

Q Okay. Can you point me to a peer-reviewed article that suggests that edge of field information from the GLEAMS model should be compared to actual 01:30PM observations of edge of field data?

A First of all, based on my 35 years of professional experience --

Q Sir --

A -- and based on -- 01:31PM

Q -- I'd like to just point out to you, I'm just asking you --

MR. BOND: I'd like you to let him answer the question.

MR. PAGE: He's going to answer it anyway 01:31PM regardless of what I ask him.

Q But I asked you a very specific question. I asked you whether you can point me to a peer-reviewed article that supports your statement under 2G, that is, that you need to get -- compare 01:31PM

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the GLEAMS output to actual observations of edge of field.

MR. BOND: So there's only two answers to your questions?

MR. PAGE: Yes or no. 01:31PM

MR. BOND: That's it?

MR. PAGE: That's it. Does he have a peer-reviewed article to support that statement or not? That was my question. You want to ask him another question, you can ask him that question. 01:31PM

MR. BOND: No. Go ahead and answer his question.

A I can't point you, sitting here, to a specific peer-reviewed paper that says the GLEAMS model must be calibrated to edge of field phosphorus loads. I 01:32PM can tell you, as I've stated on Page 16, US EPA 2008 guidance on environmental models states on Page 12, and I quote, that when applying linked models, and in this case Dr. Elm's GLEAMS -- Dr. Engel's GLEAMS and routing models are linked models, the project 01:32PM team should evaluate each component model, as well as the full system of integrated models, at each stage of the model development and evaluation. Dr. Engel compared -- used observed data at the three outlet stations to calibrate and purportedly 01:32PM

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validate both models, but as I pointed out, those data are not what GLEAMS computes.

Q And that's the same --

A My point here, sir, is that for corroboration of environmental models, they need to be confronted with data and that data need to represent what the model is actually computing. They need to be corroborated, and Dr. Engel, in fact, did not do that for his GLEAMS model. It computed edge -- I'm not finished yet, sir. It computed edge of field loads, and he did not compare it to field measurements that represented what the model was computing. 01:33PM

Q So you're relying on this document, this draft that's now final, that contains a disclaimer that says the EPA may not even -- it should not be required to follow its own modeling efforts; correct? 01:33PM

MR. BOND: Object to the form.

Q That's what your reliance is; that's the basis for your reliance? 01:33PM

A Not solely. In my 35 years of professional experience, sir, environmental models should be confronted with data. They should be corroborated. They should be calibrated. They should pass the 01:34PM

test of being confronted with data, and I'm stating the fact that Dr. Engel's GLEAMS model computes phosphors loads at edge of field and that at no point in his expert report, nor to the best of my determination in his produced materials, did he compare any of his GLEAMS computations with observed data that actually represented what that model computed. 01:34PM

Q How much of your 35 years relates to runoff modeling using tools such as SWAT, HSPF and GLEAMS? 01:34PM

A Sir, what I just told you depends on science. That is not restricted to receiving water quality models or watershed models. I have 35 years of experience in developing and applying mechanistic, process-based mass balance models. That's what SWAT is; that's what HSPF is; that's what GLEAMS is; that's what HSPF is. The science doesn't change from tool to tool. 01:34PM

Q Didn't Dr. Engel adjust any runoff components based on the observations he had at the end of each river segment so that if the GLEAMS model was showing too much runoff from a field, it was adjusted by Dr. Engel in order to calibrate the model? 01:35PM

MR. BOND: Object to the form. 01:35PM

A That is what he did, sir, but he compared the output of the GLEAMS model to data that do not represent what the GLEAMS model was computing. Therefore, it was an inappropriate comparison. The model was not being confronted with data that corresponded to edge of field phosphorus loads. 01:35PM

Q When you do a SWAT calibration, do you use the edge of the HRU data to do calibration on that model?

A I can't comment on SWAT, sir. My comments here and opinions pertain to the body of work put forth by Dr. Engel. 01:35PM

Q Well, if it doesn't -- the SWAT is a runoff model that has a routing function incorporated in it. If SWAT does not calibrate to the edge of the HRU runoff, does that indicate that your comment is not appropriate for runoff analysis? 01:36PM

A No, it doesn't because my comment pertain to mass balance models that balance water and that balance mass, in this case of phosphorus about control volumes. The intent of my comment was to point out that mass balance models need to be confronted with data and they need to be confronted with data that represent what the model is actually computing. One could with SWAT compare the -- well, 01:36PM

check that. I've answered the question.

Q Okay. So if SWAT modeling does not require an edge of the field or edge of the HRU calibration, then those models -- it's your opinion that model -- SWAT models are invalid or -- 01:37PM

A I didn't say that SWAT -- I'm making -- I'm forming no opinions and expressing no opinions about the SWAT model, other than it is a mass balance model and the science underlying -- the science underlying GLEAMS, underlying SWAT, underlying HSPF, underlying receiving water quality models is identical in that they are deterministic process-based models that balance mass, and these models compute -- the computations of these models could and should be compared to observed data. That's all I'm stating. 01:37PM

Q Does SWAT calibration or HSPF calibration require an evaluation of the HRU runoff?

A I can't give -- I refuse to give a one size fits all answer to that, sir, because it depends on context. It depends on the objectives of the project, how the model is to be used, what are the stakes, what are the consequences, what are the outcomes and whether or not it is a litigation case, and this, sir, is a litigation case. 01:37PM 01:38PM